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Missouri School of Mines.

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Catalogue.

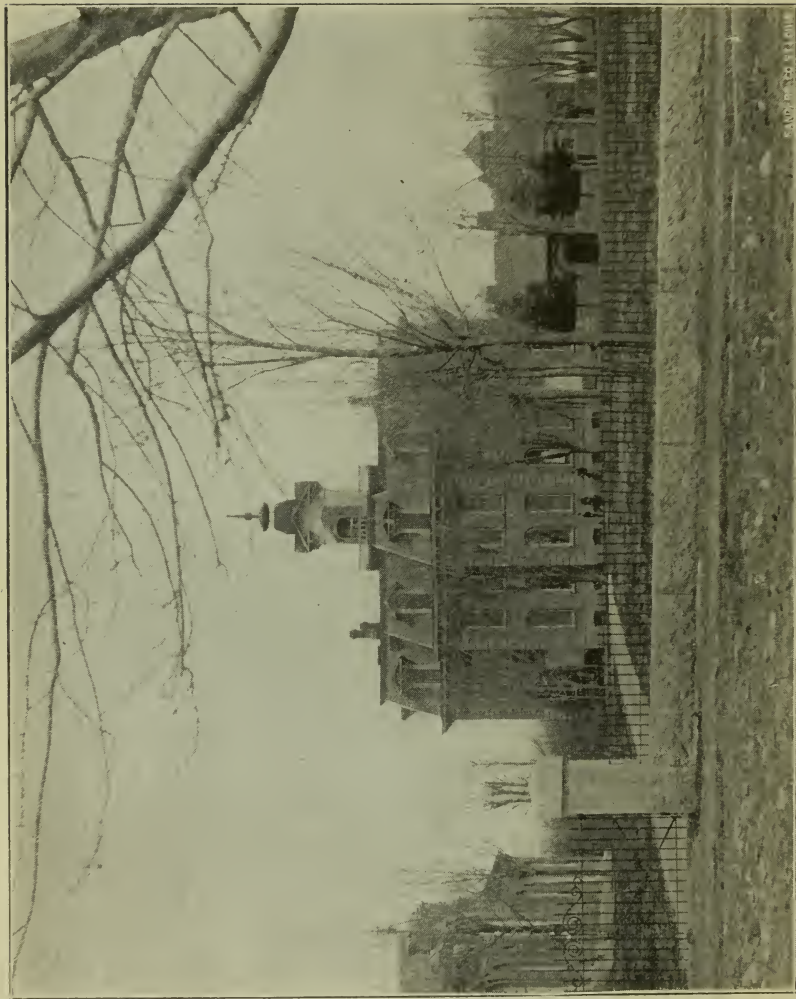
1896-7.



"WORK IS VICTORY."

—*Emerson.*





STATE OF NEW YORK

Chemical Laboratory.

Main Building.

Min. & Met. Lab.

Twenty-sixth Annual Catalogue

of the

School of Mines and Metallurgy

of the

University of the State of Missouri,

Rolla, Missouri.

1897.

ST. LOUIS:
BUXTON & SKINNER STATIONERY CO.
1897.

Calendar.

1896.

June 10, Thursday, 10 A. M. Annual Commencement.
September 11, Saturday, 10 A. M. Entrance Examinations.
September 13, Monday, 10 A. M. Entrance Examinations.
September 14, Tuesday. First Term Begins.
November 25, Thursday Thanksgiving Holiday.
December 24, Friday, 12:30 P. M. Christmas Holidays Begin.

1897.

January 3, Monday. Second Term Begins.
February 22, Tuesday. Washington's Birthday Holiday.
March 21, Monday. Third Term Begins.
June 6, Monday. Final Examinations Begin.
June 14, Tuesday. Annual Meeting of Executive
Committee.
June 14, Tuesday, 8 P. M. Society Celebration.
June 15, Wednesday, 10 A. M. Annual Commencement.

Board of Curators

OF THE

University of the State of Missouri

To January 1, 1897.

PROF. C. M. WOODWARD	-	-	-	-	St. Louis.
HON. NAT. M. SHELTON	-	-	-	-	Lancaster.
HON. W. M. EADS	-	-	-	-	Carrollton.

To January 1, 1899.

HON. R. B. OLIVER	-	-	-	-	Jackson.
G. B. ROLLINS, ESQ.	-	-	-	-	Columbia.
HON. JAS. T. MOORE	-	-	-	-	Lebanon.

To January 1, 1901.

GARDINER LATHROP, ESQ.	-	-	-	-	Kansas City.
HON. M. E. BENTON	-	-	-	-	Neosho.
†B. R. CAUTHORN, ESQ.	-	-	-	-	Mexico.
§O. D. JONES, ESQ.	-	-	-	-	EDINA.

To January 1, 1903.

REV. JOHN D. VINCIL, D. D.	-	-	-	-	St. Louis.
NOAH M. GIVEN, ESQ.	-	-	-	-	Harrisonville.
H. C. WELLS, ESQ.	-	-	-	-	Platte City.

†To May 22, 1897.

§From May 22, 1897.

OFFICERS OF THE BOARD.

*C. M. WOODWARD	-	-	-	-	President.
*NAT. M. SHELTON	-	-	-	-	Vice-president.
J. G. BABB	-	-	-	-	Secretary.
R. B. PRICE	-	-	-	-	Treasurer.

* Successor to be elected June 1, 1897.

Executive Committee

OF THE

School of Mines and Metallurgy.

HON. R. B. OLIVER	-	-	-	-	-	Jackson.
HON. M. E. BENTON	-	-	-	-	-	Neosho.
HON. J. T. MOORE	-	-	-	-	-	Lebanon.

OFFICERS OF THE COMMITTEE.

R. B. OLIVER	-	-	-	-	-	-	Chairman.
M. F. FAULKNER	-	-	-	-	-	-	Secretary.
D. W. MALCOLM	-	-	-	-	-	-	Treasurer.

Faculty.

RICHARD H. JESSE, LL.D., - - - *President of the University.*

WALTER BUCK RICHARDS, M. A., *Director and Professor of Mathematics.*
M. A., University of Virginia, 1885.

ELMO G. HARRIS, C. E., - - - *Professor of Engineering.*
C. E., University of Virginia, 1882.

COURTENAY DE KALB, - - - *Professor of Mining and Metallurgy.*

ARTHUR H. TIMMERMAN, M. M. E., - - - *Professor of Physics.*
B. S., College of City of N. Y., 1891;
M. M. E., Cornell University, 1893.

EUGENE T. ALLEN, PH. D., - - - *Professor of Chemistry.*
A. B., Amherst College, 1887; Ph. D., Johns Hopkins University, 1892.

PAUL J. WILKINS, B. S., - *Instructor in Academic Department.*
B. S., Michigan A. & M. College, 1869.

THOMAS L. RUBEY, A. M., - *Secretary and Instructor in English.*
A. M., University of Missouri, 1885.

GEORGE E. MILLER, B. S., - *Instructor in Shopwork and Drawing.*
B. S., University of Missouri, 1895.

PAUL A. LARSH, - - - *Assistant in Chemical Laboratory.*
Missouri School of Mines.

Administrative Officers.

RICHARD H. JESSE,
President of the University.

WALTER B. RICHARDS,
Director of the School of Mines.

THOMAS L. RUBEY,
Secretary of the Faculty.

PAUL J. WILKINS,
Librarian.

HISTORY.

In 1870 the General Assembly of Missouri in accepting the donation of land for educational purposes made by the general government through Act of Congress, approved July 2, 1862, established an Agricultural and Mechanical College and a School of Mines and Metallurgy. The design of these institutions is set forth in the following language:

Objects of these Colleges.—The leading objects of said colleges shall be to teach such branches as are related to agriculture and the mechanic arts and mining, including military tactics, and without excluding other scientific and classical studies, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life. (R. S. 1889, Sec. 8739.)

The Agricultural and Mechanical College was located in Boone County; the School of Mines and Metallurgy was to be located in that county of Southern Missouri which should offer the greatest inducements for such location. A commission was appointed to receive and pass upon proposals in accordance with this act, and after mature investigation and deliberation pronounced in favor of Phelps County. Here, in the next year (1871), the School of Mines began its active existence.

The statutes fix the *status* of the School as one of the colleges of the State University. Its affairs are im-

mediately under the supervision of an Executive Committee, consisting of three members of the University Board of Curators, selected by that body.

The need of general culture as a foundation and accompaniment of specifically technical training and the prevailing absence of facilities for gaining this from the reach of the intended beneficiaries of the institution led to the establishment in 1885 of an Academic Course in compliance with the following Act of Assembly:—

Academic Course of Study, etc.—That the obligations of the State to the general government, assumed by the acceptance of the land grant of July 2, 1862, may be more fully discharged, and in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life, the Board of Curators of the State University shall prescribe and adopt a liberal Academic Course of Study to be taught in the College of Mines and Metallurgy, located at Rolla, in addition to the courses now taught in said school, and may confer the degree of Bachelor of Science upon all students who shall complete said course in said school to the satisfaction of the faculty thereof. (R. S., Sec. 8740.)

The School of Mines is organized and conducted with a view to subserving, as efficiently as possible, the ends set forth in the legislative enactments in reference to it. An Academic course as provided for in the act above quoted is maintained (see p. 57), but it is kept subordinate and subsidiary to the technical work, and the School does not avail itself of the permission to confer an academic degree. The stress of its work is laid

upon its technical courses, in which only degrees are granted.

FINANCES.

The proceeds from the sale of the public lands, the grant of which has been referred to, amount to about \$350,000, which is invested in State certificates of indebtedness bearing 5 per cent. interest. The School of Mines receives one-fourth of the yearly income thus accruing. By an Act of Congress approved August 30th, 1890, commonly known as the "Morrill Bill," the general government donated to each State and territory, maintaining a college or colleges in accordance with the act of July 2d, 1862, \$15,000 for the year 1889-90 which should be increased by \$1,000 a year until the donation should reach \$25,000 a year, this to remain thenceforth an annual appropriation. After deducting one-sixteenth of this fund for the Lincoln Institute, Missouri gives one-fourth of the remainder to the School of Mines.

In 1891, the government returned to the various States the sums collected from their citizens by the imposition during the Civil War of a "direct tax." The amount thus refunded to Missouri was \$646,958.33, and the 36th General Assembly of the State won the gratitude of the friends of the higher education by establishing this as a permanent endowment for the State University, specifically designating one-fifth as the portion of the income from this source which should belong to the School of Mines. The investment of the fund in

5 per cent. State certificates yields to the school annually \$6,469.58.

From these three sources, then, the school enjoys an annual revenue of about \$16,000. Such additional sums as are necessary for its support are furnished by biennial legislative appropriations.

LOCATION.

The School of Mines is situated at Rolla, the county seat of Phelps County. Rolla is a town of about 2,000 inhabitants, on the St. Louis and San Francisco R. R., approximately half way between St. Louis and Springfield. It has an elevation of 1,140 feet above the sea level, and enjoys an agreeable and notably healthful climate. Not infrequently families from less favored climates move hither, seeking at once the health of the older members, the education of the younger. Its position on a great transcontinental railway system renders it readily accessible from all quarters. It is within easy reach of the lead and zinc district of the southwest, and of the lead and iron regions of the southeast, while opportunities to observe processes of mining and smelting the latter ores are close at hand. The numerous and varied smelting and chemical plants in and about St. Louis, likewise offer good opportunities for the study of their processes.

A large amount of practical work in ore-dressing and metallurgy is regularly done by the students themselves in the well-equipped Mining and Metallurgical

Laboratory (see p. 73), and in addition, classes make visits, under the guidance of a professor, to mining fields and metallurgical works in order to witness their operations upon a large scale. In the last few years such visits have been paid to the Sligo Iron Furnace, in Crawford County, Mo.; the mines and lead works of the St. Joseph Lead Co., at Bonne Terre, Mo.; the smelters at Herculaneum, Mo., and Belleville, Ills.; and the Tudor Iron Works of St. Louis. The thanks of the School are due to the officials in charge of these plants for their courtesies.

TECHNICAL COURSES.

PLAN OF INSTRUCTION.

It is the object of the instruction at this institution, first, to lay a broad and solid foundation in the way of acquaintance with principles and theory, and to supplement this, wherever possible, by the discipline of practical application in the laboratory and the field. Lectures and recitations are arranged to come in the morning hours, leaving the afternoon for laboratory and field work. This practical work is designed to illustrate and impress principles, to familiarize with the use of instruments and apparatus, to give valuable experience in operations with which the student is to be concerned in the work of his profession, and to afford an opportunity for original investigation. "Head-work" and "hand-work" go together. What is taught orally in the lecture room is applied, illustrated, and

enforced in the laboratory. The School is excellently provided with laboratories and equipment, of which it makes a large use.

ADMISSION.

Under the statutes persons of either sex, sixteen years of age or over, whether residents of Missouri or not, are admissible upon evidence of sufficient preparation. Students should acquire a good liberal education, its elements at least, before beginning technical study. Age is not an infallible criterion of advancement, but, as a rule, they would do best to continue their general studies until they are seventeen or eighteen. The average age of the present Freshman Class at entrance was 18.7 years; only two members were less than 17. The general test of admittance that is sought to be applied is the fitness of the applicant to pursue profitably the courses here offered. Specific requirements have been fixed by considerations of the express design of the School—"to promote the education of the industrial classes" in certain branches of engineering—and of the educational opportunities of its intended beneficiaries. The School does not wish nor intend to do the work customarily done in the public schools throughout the State, nor, on the other hand, to set its entrance conditions beyond the reach of the majority of those whose interests were chiefly contemplated in its establishment. The requirements for entrance to the Freshman Class, are as follows:

1. English Grammar and Composition. Rules of Syntax; Analysis of Sentences; Correction of ungrammatical expressions. An essay upon one of several topics assigned will be required, and this will be graded with respect to spelling, punctuation, use of capitals, grammatical correctness and thought.

2. Elementary Algebra—as far as Quadratics. Use of Signs, Factoring, Highest Common Factor, Lowest Common Multiple Fractions, Simple Equations, Square Root and Cubic Root, Exponents.

3. Elementary Physics. Properties of Matter, Laws of Motion, Mechanics of Fluids, Heat.

In 1898 it is expected to require three books of Plane Geometry.

Entrance examinations in these subjects will be given on Saturday, Sept. 11th, and Monday, Sept. 13th, 1897. Earlier examinations and examinations at a distance may be arranged by application to the Director.

Applicants may be admitted upon certificate from a preparatory school, when the faculty is satisfied that the work certified to covers the above requirements.

Following is a list of Schools whose courses have been approved by the University, and whose diplomas will admit to the Freshman Class without examination. By an order of the Board of Curators the student who obtains the highest rank in the graduating class of any of these schools will be admitted without the payment for the first year of the usual entrance fee.

NAME OF SCHOOL.	SUPERINTENDENT AND PRINCIPAL.
Appleton City Academy.....	G. A. Thielman.
Bethany High School.....	J. R. Hale.
Bolivar High School.....	C. T. Wright.
Brookfield College.....	M. H. Reaser.
Buchanan College, Troy, Mo.....	Wm. F. Roberts.
Butler Academy.....	John W. Richardson.
Cameron High School	{ B. Riggs. Miss Bertha Ensign.
Carrollton High School.....	{ L. W. Rader. Mrs. R. R. Quisenberry.
Carthage High School....	{ W. J. Stevens. E. E. Dodd.
Chillicothe High School.....	{ W. F. Jamison. S. E. Stout.
Clinton High School	{ C. B. Reynolds. Mrs. C. D. Price.
Columbia High School.....	R. H. Emberson.
Culver Military Academy, Marmont, Ind.....	A. F. Fleet.
Ft. Smith High School, Ft. Smith, Ark.....	J. L. Holloway.
Hannibal High School.....	{ R. B. Simonson. Miss Gertrude Ashmore
Harrisonville High School.....	A. F. Treakele.
Higginsville High School.....	H. B. Walker.
Independence High School	{ Wm. F. Bahlman. Wm. L. C. Palmer.
Joplin High School.....	{ W. B. Brown. J. D. Elliff.
Kansas City High School.....	{ J. M. Greenwood. John T. Buchanan.
Kemper Family School, Boonville, Mo.....	T. A. Johnson.
Kirkwood High School.....	W. S. Dearmont.
Lamar High School.....	W. H. Martin.
Lancaster High School.....	W. C. Thompson.
Louisiana High School.....	{ A. P. Settle. R. R. Rowley.
Marmaduke Military Academy, Sweet Springs, Mo.	
Marshall High School.....	{ T. E. Spencer. C. A. Snodgrass.
Maryville High School	{ A. E. Clarendon. B. F. Duncan.

Marionville Collegiate Institute, Marionville, Mo.	M. L. Curl.
Mexico High School.....	{ D. A. McMillan. O. K. Brown.
Miami High School.....	E. E. Barnett.
Michigan Millitary Academy, Orchard Lake, Mich.	W. H. Butts.
Moberly High School	{ H. H. Holmes. J. A. Whiteford.
Monroe City High School.....	R. S. Nichols.
Montgomery City High School.....	L. J. Hall.
Mound City High School.....	J. P. Coleman.
Mt. Vernon Academy, Mt. Vernon, Mo.....	G. H. Pollard.
Nevada High School.....	W. J. Hawkins.
Paris High School.....	W. D. Christian.
Richmond High School.	{ J. M. Baily. J. E. Dunu.
Rockport High Schools	B. F. Brown.
Sedalia High School... ..	{ G. V. Buchanan. J. D. Wilson.
Shelbina High School.....	J. T. Vaughn.
Slater High School	G. W. Newton.
Springfield High School	{ J. Fairbanks. W. T. Carrington.
St. Joseph High School.....	{ Edward B. Neely. C. E. Miller.
St. James Military Academy, Macon City, Mo....	F. W. Blees.
St. Louis High School	{ F. Louis Soldan. W. J. S. Bryan.
Trenton High School	{ H. E. DuBois. E. M. Painter.
University Academy, Columbia, Mo.....	G. H. Beasley.
Wentworth Military Academy, Lexington, Mo...	Sanford Sellers.
Westport High School.....	{ S. A. Underwood. Sarah E. Steele.
Woodson Institute, Richmond.....	B. G. Shackelford.

Candidates may be admitted to "advanced standing" (that is to enter the Sophomore or the Junior class) either upon examination in the subjects of the previous

* Where two names are given the first is that of the Superintendent and the second that of the Principal.

year or years, or upon certificate from another institution of work in the estimation of the Faculty fairly equivalent to that done here by the class into which entrance is sought. Applicants for advanced standing should communicate with the Director as early as possible.

COURSES OF STUDY.

The School of Mines offers three complete Technical Courses, extending through four years, viz.:—

- I. MINING ENGINEERING.
- II. CIVIL ENGINEERING.
- III. CHEMISTRY AND METALLURGY.

Course I. is a general course in Mining Engineering, having in view all the operations in connection with mining, from the prospecting for the mine to the delivery of the finished product on the market.

Course II. is a course in Engineering as applied especially to Railways, Highways and Municipal Works.

Course III. contemplates especially processes in Mining and Metallurgy subsequent to the delivery of the ore above ground. It fits a man for a position as Chemist and Assayer or in other connection with concentrating plants and smelters.

Certain options are offered as the candidate may wish to specialize in the direction of Metallurgy or of Analytical Chemistry.

For the completion of any of these courses the degree of Bachelor of Science is given. The further de-

gree of Engineer of Mines, Civil Engineer or Metallurgical Engineer will either be conferred for an additional year's post-graduate work, approved in quantity and character by the Faculty; or may be awarded to graduates who have had practical experience in the work of their profession of such duration and value as to warrant its bestowal.

Each applicant for a degree is required during his Senior year to present to the Faculty a Thesis, recording the result of some original investigation or independent research in a subject connected with his course. It must be accompanied with any drawings that may be necessary to illustrate it, and a copy of it must be deposited with the Librarian for preservation. The acceptance of this Thesis as satisfactory is a condition of graduation.

TERMS.

Beginning with next year it is proposed to make a noteworthy and important change in the subdivision of the scholastic year. It will be divided into three terms; the first beginning Sept. 13th, and ending with the Christmas holidays; the second extending from the first Monday in January—the 3d—to the 18th of March; and the third from the 20th of March to the end of the session, June 15th, 1898. At the same time the instruction has been re-distributed, so as to attain greater concentration. It is believed that the multiplicity of subjects which colleges often require their students to take simultaneously is a serious defect in

their courses. To compel a man to carry half a dozen different branches, each calling for two or three recitations a week, is apt to produce a state of mental confusion, not productive of the best results. It is believed that greater ease of acquisition and more enduring benefit will ensue from an arrangement in which a smaller number of topics is studied at a time, each receiving a proportionately greater amount of attention, for a shorter period. The content of the courses is substantially the same as at present and each branch receives about the same number of hours as in the existing schedule; thus where formerly a subject was assigned three hours a week, for a term of eighteen weeks, it will now be given five hours a week for a term of eleven weeks. In any year probably the same ground as before will be covered, but certain subjects will be completed and laid aside before others are taken up, reducing the number of lines of thought to be carried in the head at once.

Additional advantages are that the Christmas holidays will come between terms, and not in the midst of a term; and that a student who is unable to spend the whole year, may, in a shorter time, get more of the specialty which he desires.

Following is a table giving the distribution of the work required in the courses, with the number of exercises per week in each subject. Readers who seek information as to the content of any course should study it as outlined in the table, turning to the subsequent departmental statements for description of the instruction given in the various subjects:

FRESHMAN YEAR.

MINING ENGINEERING.	Times per week.	CIVIL ENGINEERING.	Times per week.	CHEMISTRY AND METALLURGY.	Times per week.
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FIRST TERM.

Geometry.....	5	Geometry.....	5	Geometry.....	5
General Chemistry.....	4	General Chemistry.....	4	General Chemistry.....	4
Higher Algebra.....	5	Higher Algebra.....	5	Higher Algebra.....	5
Chemical Laboratory....	1	Chemical Laboratory....	1	Chemical Laboratory....	1
Drawing	2	Drawing	2	Drawing	2
Shop Practice	2	Shop Practice.....	2	Shop Practice.....	2

SECOND TERM.

Geometry.....	5	Geometry.....	5	Geometry.....	5
English.....	5	English.....	5	English.....	5
{ Higher Algebra and Trigonometry	5	{ Higher Algebra and Trigonometry	5	{ Higher Algebra and Trigonometry	5
Chemical Laboratory....	1	Chemical Laboratory....	1	Chemical Laboratory....	1
Drawing	2	Drawing	2	Drawing	2
Shop Practice.....	2	Shop Practice.....	2	Shop Practice.....	2

THIRD TERM.

Physics.....	5	Physics.....	5	Physics.....	5
English.....	5	English.....	5	English.....	5
Trigonometry	5	Trigonometry	5	Trigonometry	5
Chemical Laboratory....	1	Chemical Laboratory....	1	Chemical Laboratory....	1
Drawing	2	Drawing.....	2	Drawing	2
Shop Practice.....	2	Shop Practice.....	2	Shop Practice.....	2

SOPHOMORE YEAR.

MINING ENGINEERING.	Times per week.	CIVIL ENGINEERING.	Times per week.	CHEMISTRY AND METALLURGY.	Times per week.
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FIRST TERM.

Analytical Geometry....	5	Analytical Geometry....	5	Analytical Geometry....	5
Surveying	3	Surveying	3	Elective.....	3
Inorganic Chemistry....	4	Inorganic Chemistry....	4	Inorganic Chemistry....	4
French or German.....	3	French or German.....	3	German.....	3
Chemical Laboratory....	2	Chemical Laboratory....	2	Chemical Laboratory....	5
Field Practice.....	3	Field Practice.....	3		

SECOND TERM.

Descriptive Geometry... 5	Descriptive Geometry... 5	Descriptive Geometry... 5
French or German..... 3	French or German..... 3	German..... 3
Analytical Geometry.... 2	Analytical Geometry.... 2	Analytical Geometry.... 2
Applied Chemistry..... 5	Applied Chemistry..... 5	Applied Chemistry..... 5
Chemical Laboratory.... 3	Chemical Laboratory.... 3	Chemical Laboratory.... 2
Drawing	Drawing	Drawing

THIRD TERM.

Differential Calculus.... 5	Differential Calculus.... 5	Differential Calculus.... 5
Physics	Physics	Physics
French or German..... 5	French or German..... 5	German..... 5
Chemical Laboratory.... 4	Chemical Laboratory.... 1	Chemical Laboratory.... 5
Field Practice..... 1	Field Practice..... 4	

JUNIOR YEAR.

MINING ENGINEERING.	Times per week.	CIVIL ENGINEERING.	Times per week.	CHEMISTRY AND METALLURGY.	Times per week.
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FIRST TERM.

Physics.....	5	Physics.....	5	Physics.....	5
French or German.....	5	French or German.....	5	German.....	5
Integral Calculus.....	3	Integral Calculus.....	3	Integral Calculus.....	3
Mineralogy.....	2	Physical Laboratory....	2	Mineralogy.....	2
Chemical Laboratory....	3	{ Drawing and Field		Chemical Laboratory....	2
Physical Laboratory....	2	{ Practice	3	Physical Laboratory....	2
Practical Ore Dressing..	Mon.			Practical Ore Dressing..	Mon.

SECOND TERM.

Ore Dressing.....	4	Elective.....	5	Ore Dressing.....	4
Physics.....	2	Physics.....	2	Physics.....	2
Masonry Construction... 3		Masonry Construction... 3		Theoretical Chemistry.. 5	
Mining.....	3	Mineralogy.....	2	Mineralogy.....	2
Mineralogy.....	2	Physical Laboratory....	2	Chemical Laboratory....	3
Chemical Laboratory....	3	Drawing.....	3	Physical Laboratory....	2
Physical Laboratory....	2				

THIRD TERM.

Mining.....	5	Lines of Communication	5	Elective.....	4
Metallurgy.....	4	Metallurgy.....	4	Metallurgy.....	4
Mechanics.....	5	Mechanics.....	5	Theoretical Chemistry.. 5	
Stereotomy.....	1	Stereotomy.....	1	Stereotomy.....	1
Physical Laboratory....	2	Physical Laboratory....	2	Physical Laboratory....	2
{ Drawing and Field		{ Drawing and Field		Chemical Laboratory....	2
{ Practice.....	2	{ Practice.....	3	Practical Ore Dressing..	Mon.
Practical Ore Dressing..	Mon.				

SENIOR YEAR.

MINING ENGINEERING.	Times per week.	CIVIL ENGINEERING.	Times per week.	CHEMISTRY AND METALLURGY.	Times per week.
FIRST TERM.					
Geology.....	5	Geology.....	5	Geology.....	5
Metallurgy.....	5	Astronomy	3	Metallurgy.....	5
Framed Structures.....	5	Framed Structures.....	5	Thermo-Dynamics.....	2
Designing	3	{ Drawing and Field Practice.....	5	Organic Chemistry	3
Metallurgical Laboratory	Mon.			Designing	3
				Chemical Laboratory....	1
				Metallurgical Laboratory	Mon.

SECOND TERM.

Electrical Transmission.	5	Electrical Transmission.	5	Organic Chemistry.....	2
Hydraulics	5	Hydraulics	5	Masonry Construction...	2
Metallurgy.....	5	Elective.....	3	Metallurgy.....	5
Physical Laboratory....	2	Physical Laboratory....	3	Electro-Metallurgy	4
Designing	2	Designing and Drawing.	2	Physical Laboratory	3
				Chemical Laboratory....	2

THIRD TERM.

Steam Engineering.... }	3	Steam Engineering.... }	3	Organic Chemistry.....	4
Power Transmission.... }		Power Transmission.... }		Geology.....	3
Geology.....	3	Geology.....	3	Metallurgical Problems..	2
Electrical Transmission.	1	Electrical Transmission.	1	{ Chemical Laboratory and Thesis.....	5
Thesis.....	5	Bridge and Sanitary Eng	3		
Metallurgical Laboratory	Mon.	Thesis	5	Metallurgical Laboratory	Mon.

REMARKS ON THE COURSES.

The courses are identically the same in the Freshman year, and differ but slightly in the Sophomore. The student has thus an opportunity to defer his choice of a specialty until he has spent some time in technical study, and can better estimate his inclinations and capacities.

The course in Chemistry and Metallurgy may be taken as here laid down; or those who wish to become chemists, rather than metallurgists, may substitute equivalent chemical work for Stereotomy and Masonry Construction, while those having Metallurgy rather than Chemistry in view, have the same privilege as respects Organic Chemistry.

To each lecture or recitation one hour is devoted. Mineralogy, which is taught partly by oral methods but chiefly through determinative work in the laboratory, covers two-hour periods. The afternoon periods, given to laboratory, drawing and field-work, are of three hours, except in the chemical laboratory after the Freshman year, where they are of four hours. The work in Practical Ore Dressing consumes all of the Mondays assigned to it.

SPECIAL COURSES.

For the benefit of those who may lack the time, the money or the inclination to spend four years in preparation for professional work, certain special courses, designed to confer competent knowledge of particular departments of engineering work are offered. These are:

I. ASSAYING AND TECHNICAL ANALYSIS.

This course, which is outlined on pages 39-41 may, with diligence, be completed by mature students who have some knowledge of Chemistry, in one year. An additional year, which will in some cases be necessary, may in all cases be profitably spent in more work in Analytical Chemistry and related electives.

II. SURVEYING.

The purpose of this course is to turn out competent Land and Mine Surveyors and fair draughtsmen. The essentials of it are a thorough knowledge of Algebra, Geometry, Trigonometry, Surveying, Descriptive Geometry and Stereotomy, with Field Practice and Drawing. It may be completed in one year or in two years, according to the advancement of the applicant upon entrance. By combining with this the courses in Mineralogy, Geology, Mining and Ore-dressing, industrious students, especially such as have had some practical experience, may in two years attain considerable competency for the conduct of mining operations.

III. ELECTRICITY.

A knowledge of the theory of Electricity and some acquaintance with its manifold applications in the arts is in these days of prime importance to every engineer—especially to the mining engineer, whose duties are so varied. Hence, in the regular courses this subject receives a liberal share of attention. The School does not design to offer a course in electrical engineering, but students who have completed satisfactorily the courses in Shop Work, in Chemistry through the Sophomore year, in Mathematics through the Calculus, and in General Physics, with all the undergraduate work, both theoretical and practical, in Electricity and Magnetism as outlined on pages 34-38, will have attained a considerable proficiency in Electricity, theoretical and applied.

Applicants will be admitted to these courses only when they are of such maturity, have had such preparation, and evince such seriousness of intention as to indicate that they are likely to pursue the same with profit. Matriculates in any of the regular degree courses will not be allowed to lapse into a special course except upon presentation to the Faculty of convincing reasons for such change. Special students whose work is chiefly of a laboratory nature will be required to take at the same time enough recitation work to employ properly their time outside of laboratory hours.

MATHEMATICS.

PROF. RICHARDS.

The exceeding importance of Mathematics as the basis of a scientific education justifies the emphasis laid upon it in the school. At the same time that the facts are taught, the utility of mathematical study as a mental discipline is duly recognized, and an effort is made to promote habits of exact logical reasoning, and to stimulate originality and independence of thought.

In the various courses the ultimate intention of the student is kept prominently in mind, and such points as have an especial bearing upon his technical work are emphasized as occasion may suggest. The tendency, however, too frequently observable in technical schools, to cramp the mathematical instruction within the limits of a meager preparation for professional work, is avoided, and the treatment of each subject is, in general, designed to be as broad and full as may be in the allotted time.

At each meeting the class is examined on matter previously assigned, and, when expedient, explanations of the text and supplementary lectures and notes are given. The student is constantly exercised in work at the blackboard, reproducing demonstrations and applying demonstrated principles to the solution of special problems.

1. GEOMETRY.—The class completes the usual course in Elementary Geometry, Plane and Solid, with numerous original exercises. (Freshman, first and second terms, five times a week.)

Text-book.—Wells' Plane and Solid Geometry.

2. HIGHER ALGEBRA.—At the outset the class will review Radicals and Quadratic Equations. Thereafter the course will include Theory of Exponents, Surds, Imaginaries, the Progressions, Permutations and Combinations, Binomial Theorem, Series, Logarithms, Theory of Numbers, Determinants, with an introduction to the Theory of Equations. (Freshman, five times a week for four months.)

Text-book.—Wells' University Algebra, with notes,

3. TRIGONOMETRY, PLANE AND SPHERICAL.—The class is thoroughly drilled in the Fundamental Definitions and Formulae, and exercised in the manipulation of trigonometric equations. The construction and use of Logarithmic tables are taught, and numerous examples in the solution of triangles, involving the use of Logarithms, are given. Occasionally actual heights and distances are required to be calculated by trigonometric methods.

The course in Spherical Trigonometry includes some applications in Geodesy and Astronomy. The analogy between the formulae of Plane and of Spherical Trigonometry is pointed out, and it is shown how the former may be deduced from the latter by supposing the radius of the sphere to become infinite. (Freshman, five times a week for five months.)

Text-book.—Wells' Plane and Spherical Trigonometry.

4. ANALYTICAL GEOMETRY (PLANE).—The course comprises an elementary but fairly complete study of the Conic Sections, and a few of the most important and interesting curves of higher degree. Early in the course a few lectures on differentiation are given, and the student is taught to use the method in finding equations of tangents and normals. (Sophomore, first term, five times a week.)

Text-book.—Wentworth's Analytic Geometry.

For Reference.—Puckle's Conic Sections, Salmon's Conic Sections and Higher Plane Curves.

5. ANALYTIC GEOMETRY (SOLID).—The instruction includes an elementary discussion of the Line, the Plane, and surfaces of the second degree. Wentworth's Analytic Geometry is continued as a text-book, but the treatment on the subject there given is supplemented by notes. (Sophomore, second term, twice a week for six weeks.)

6. DIFFERENTIAL CALCULUS.—The design of the course is, first to give the student a correct and logical view of the foundation of the subject, to derive its working formula, and to secure by varied practice facility in using them, and thereafter to present a number of its applications in Geometry and Mechanics. The method of limits is used, and care is taken that the student shall not view the Calculus as some certain body of mathematical knowledge, having fixed boundaries, but shall see it in its true light as a method of

analysis, the applications of which are theoretically infinite. Among the topics discussed are evaluation of indeterminate forms, expansion of functions by Taylor's Theorem, maxima and minima values of functions, and the analytical study of curves. (Sophomore, second term, twice a week for five weeks; third term, five times a week.)

Text-book.—Osborne's Calculus, with lectures.

For Reference.—Williamson, Todhunter, etc.

7. INTEGRAL CALCULUS.—Many problems in integration are solved, and the method is applied to the finding of lengths, areas, volumes and moments of inertia of various curves and surfaces. If time permits at the end of the course a few lectures introductory to Differential Equations will be given. This was done in 1897.

The work in Analytic Mechanics, for several years done in this department, has been retransferred to the department of Physics.

GRADUATE COURSES.

Graduate students who elect work in this department will be permitted to exercise considerable latitude of choice, within the approval of the Professor. They may make a wider study of the Conic Sections by both Algebraic and Projective methods (Salmon, Cremona), Advanced Calculus (Williamson), Theory of Equations (Burnside and Panton), Determinants (Muir or Weld). Or, if they desire to pursue subjects more directly related to the physical sciences, they may take Dynamics

(Williamson), Differential Equations (Johnson), Quaternions (Kelland and Tait).

In all the classes, as each subject is taken up its origin and development are studied too, and at certain periods more formal lectures on the History of Mathematics are given.

A collection of the chief works on Mathematics, in English, French and German, which is contained in the Library, affords the student an opportunity of extending his research at will.

PHYSICS.

PROF. TIMMERMAN.

1. **ELEMENTARY PHYSICS.**—Some acquaintance with Elementary Physics is required for entrance, but a more extended and thorough knowledge of the elements is given, as an introduction to the work of the Sophomore and Junior years. The fundamental principles of Physics are discussed as fully as the time allotted will permit. The work is carried on by lecture and recitation; the lectures being illustrated by simple experiments. (Freshman, third term, five times a week.)

Text-book.—Elements of Physics, by Carhart and Chute.

2. **ELECTRICITY AND MAGNETISM.**—Lectures and recitations three hours a week during the first term. This course is designed as an introduction to the study

of Electricity and Magnetism. Open to all who have completed 1.

Text-book.—Lessons in Electricity and Magnetism, by S. P. Thompson.

3. PRACTICAL ELECTRICITY.—Lectures and recitations three hours a week during the second term. The work during this term deals with the principles underlying the construction of dynamos and motors. Open to all who have completed 1 and 2.

Text-book.—Slingo and Brooker's Electrical Engineering.

4. LABORATORY WORK IN ELECTRICITY AND MAGNETISM.—Two afternoons a week throughout the year.

5. GENERAL PHYSICS.—The study of advanced physics is taken up during the third term of the Sophomore year, and continued during the first and second terms of the Junior. The Sophomores study Kinematics, Statics, Kinetics, and the Mechanics of Fluids during the first part of the term, and conclude with the subject of Light toward the last of the term. Particular attention is paid to harmonic motion as the basis for the study of the subjects of Sound, Light and Alternating Currents of Electricity. (Five times a week during the third term.)

During the first and second terms of the Junior year the work in Physics is continued in the following order: Sound, Heat and Electricity and Magnetism. The study of Heat includes an introduction to Thermodynamics. In the work in Electricity and Magnetism particular attention is paid to the magnitude of the

electro-static and of the electro-magnetic units as a necessary aid to the comprehension of such terms as potential, current, capacity, etc. (Five times a week during the first term and twice a week during the second term.)

The work is carried on by lecture and recitation. The lectures are illustrated by experiment. The method of the Calculus is employed throughout.

At the end of the course several lectures on the Electro-Magnetic Theory of Light are given.

Text-book.—Carhart's University Physics.

6. LABORATORY WORK IN MECHANICS, SOUND, LIGHT, HEAT, ELECTRICITY AND MAGNETISM.—In the laboratory the work is quantitative and aims as far as possible to instruct the student in the methods of physical measurements and the derivation of relation among the quantities measured. Emphasis is laid upon the derivation of physical laws rather than the verification of them. Required of Juniors in all courses, two afternoons a week throughout the year.

7. ELECTRICAL TRANSMISSION OF ENERGY.—The Seniors meet five times a week during the second term and once a week during the third term for the study of Electrical Transmission. The course includes a discussion of the magnetic circuit of dynamos and motors, operation of dynamos and motors with methods of connecting both in series and in parallel; characteristic curves; efficiency, methods of testing, etc. The subject of alternating currents is then discussed by analytical and graphical methods; this includes transformers,

alternators, and polyphase generators and motors. The remainder of the time is given to the construction of conduits, pole lines, etc., and to a discussion of the various methods of series and parallel distribution of electrical energy; including designs of plants for minimum first cost, for maximum economy, etc. Lectures and recitations.

8. **ELECTRO-METALLURGY**.—This course includes a general discussion of solution and electrolysis with their applications in chemistry and metallurgy. The principal methods employed are discussed in detail. Four times a week during the second term. Required of Seniors in the course in Chemistry and Metallurgy. The work is carried on by lecture and recitation.

9. **THERMODYNAMICS**.—A short course including the application of thermo-dynamics to chemical and physical processes. Twice a week during the first term. Required of Seniors in the course in Chemistry and Metallurgy.

10. **DYNAMO LABORATORY**.—The work in the Dynamo Laboratory includes calibration of instruments, characteristic curves of dynamos and motors, efficiency tests of dynamos, motors, alternators, transformers, etc. Required of Seniors in Civil Engineering three times a week during the second term, and of Seniors in Mining Engineering twice a week during the second term.

11. **ELECTRO-METALLURGY**.—Laboratory work, including operation of dynamos and motors; electrolytic determination and separation of metals, etc. Three

times a week during the second term. Required of Seniors in Chemistry and Metallurgy.

12. MECHANICS OF ENGINEERING.—During the third term a course in mechanics of engineering is given. The work includes statics and kinetics with their applications to engineering problems. Such subjects as center of inertia, moment of inertia; work, energy, power, friction, etc., are treated at some length. Required of Juniors in the C. E. and M. E. courses, five times a week during the third term.

Text-book—Mechanics of Engineering by I. P. Church.

Laboratory Text-books.—Stewart and Gee, Vol. I, Elementary Practical Physics, and Vol. II Electricity and Magnetism; E. L. Nichols, Laboratory Manual, Vol. I and Vol. II; Kohlrausch, Physical Measurements; Carhart and Patterson, Electrical Measurements; Ostwald, Physico-Chemical Measurements.

GRADUATE COURSES.

13. THEORY OF ELECTRICITY AND MAGNETISM.—A mathematical treatment of the subject. Three hours a week during the first and second terms. Open to graduates and advanced undergraduates.

Text-book.—Electricity and Magnetism, by F. E. Nipher.

14. ALTERNATING CURRENTS.—An analytical and geometrical treatment of the subject. Two hours a week during the first and second terms. Open to graduates and to advanced undergraduates.

CHEMISTRY.

PROF. ALLEN. MR. LARSH.

The courses in this department are intended for technical students and while the application of chemical principles is made in a practical way throughout the work, all the instruction aims to eliminate the "rule of thumb," and lays stress on the importance of principle.

The following courses are given:

1. GENERAL CHEMISTRY.—Four hours of classroom work per week for two terms. Laboratory work one hour per week for one year. The experiments are mostly quantitative, and are intended to teach from the first stoichiometrical relations.

a. First half. (Freshman Year, 1st term.) Fundamental principles, the Chemistry of a few typical elements.

b. Second half. (Sophomore Year, 1st term.) A comprehensive study of the more important elements. Especial attention is given to the Chemistry of the metals. The Periodic Law is followed throughout.

2. QUALITATIVE ANALYSIS.—The equivalent of three afternoons per week for two terms in all courses.

Chiefly laboratory work, though a number of lectures are given, and quizzes are held from time to time.

Students in the C. and M. Course employ some time, at the close of their work, in a qualitative problem

given by the instructor, which they solve in the laboratory, and upon which they make a written report.

3. QUANTITATIVE ANALYSIS.—The equivalent of three afternoons per week for one year in the M. E. Course, and four afternoons in the C. and M. Course.

The first term's work is planned more especially to teach exactness, though the problems are all such as would be met with in practical work. The important acids are determined. Then follow determinations of calcium, barium, magnesium, aluminum, and the analysis of iron, zinc, lead and copper ores. A part of the last term is given to the fire-assay of gold, silver and lead, and the analysis of fuels.

Students of the C. and M. Course devote the last term of the Junior Year to Water Analysis, Gas Analysis, etc.

Text-book.—Fresenius. (Standard works of reference are to be found in the laboratory at the disposal of the student.)

4. APPLIED CHEMISTRY.—Five hours per week during the second term of Sophomore Year.

A course of lectures treating the chemical principles involved in the following subjects:

(a.) Sanitary Chemistry.

The Atmosphere, Air Analysis, as related to Ventilation, Disinfection, Natural Waters, Water Analysis, Water Supply, Sewage and Sewage Disposal.

(b.) Industrial Chemistry.

Fuels, Illuminants, Refractory Materials, Building Materials, Wood Preservatives, Paints, Varnishes,

Explosives, etc. The aim is to treat those subjects most likely to be needed by engineers in their practice. Students are required to make a report on some chemical plant, industry or the like, as a result of summer observation and study. No text is used.

5. THEORETICAL CHEMISTRY.—Five hours, second and third terms, Junior Year, for students in the C. and M. Course. The lectures deal with present theories of Chemistry, and their development as follows:

Beginnings of Quantitative Work, Laws of Chemical Combination, Atomic Theory, Avogadro's Law, Molecular and Atomic Weights, Interrelations of Atoms, Periodic Law, Constitution of the Molecule, Stereo-Chemistry, Solutions, Chemical Reactions, Equilibrium of Chemical Systems, Reaction Velocity, Thermo-Chemistry.

The sources are the recognized authorities in each department of the subject—Kopp, Hoefer, Wurtz, Ernst von Meyer, Lothar Meyer, Muir, Ostwald, Nernst, Mendeleeff.

No text-book was used in 1896-7.

6. TECHNICAL ANALYSIS AND ASSAYING.—One year, four afternoons per week. This embraces especially fire assaying for gold, silver and lead-ores and commercial methods for iron, zinc, lead and copper ores, and furnace products.

Students must have a knowledge of General Chemistry and Qualitative Analysis before taking this work. An Assayer's certificate is given to students who satisfactorily complete Courses 1, 2, 4 and 6.

7. **ORGANIC CHEMISTRY.**—Students in Course III take this subject four hours a week in the third term of the Junior Year, and three hours and two hours respectively in the first and second terms of the Senior Year.

Laboratory work in Organic Synthesis comes one hour in the first term, Senior Year, and two hours in the second term.

8. **THESIS.**—Students in Course III, specializing in Chemistry, take Thesis Work five times per week in the last term of the Senior Year.

ENGINEERING.

PROF. HARRIS.

G. E. Miller, Instructor in Shop Work and Drawing.

1. **SURVEYING.**—First the field instruments of the engineer are dissected and studied in every detail—their theory, adjustment and construction, each receiving careful attention. Their uses and capabilities are thoroughly discussed and applied in Field Practice. Every student is required to adjust and use the various instruments until he is familiar with them. Next are studied: Surveys for boundaries, areas and subdivisions of land, including Government subdivisions; city, mine, topographical and hydrographical surveying.

The Field Exercises are selected with the intention of giving as great variety as possible. A complete topographical map, made from notes taken in

the field, is required of every student during the Sophomore Year. (Sophomore, first term, three recitations and three afternoons of field practice a week.)

2. DESCRIPTIVE GEOMETRY.—Theory of parallel and of central projections as applied to the science of drawing, with daily blackboard exercises in presenting the projections of familiar objects, intersections of plane and curved surfaces, sections, shadows, and perspectives. The afternoons in the drawing room are devoted to the solution of more elaborate exercises, completion of the topographical map, and a finished drawing in isometric and in prospective. (Sophomore, second term, five recitations and two afternoons of drawing a week.)

Text-book.—Low's Descriptive Geometry.

3. MASONRY CONSTRUCTION.—This course treats of the economic properties of building stone, brick and cements; the proportioning, mixing and placing of concrete; preparation of foundations, and strength and stability of masonry structures, including heavy buildings, dams, piers, abutments, retaining walls and arches. Each student is required to test, according to standard specifications, several brands of cement, and to analyze and trace the resultant of the forces acting on several important masonry structures. (Junior, second term, three times a week.)

Text-book.—Baker's Masonry Construction.

4. LINES OF COMMUNICATIONS.—This course is devoted to the surveys for railways, highways and canals; the setting out, estimating and execution of earthwork.

In the assigned afternoons the student is drilled in the most satisfactory methods of accomplishing such surveys. Each student is assigned a section in superintendence of which he must set out and estimate the earthwork for a railway. In the drawing room he will make maps and profiles of the surveys as set out. Other exercises in draughting will be assigned, as time for their completion is available. (Junior, third term, five lectures and three afternoons of field practice a week.)

5. STEREOTOMY.—The application of Descriptive Geometry to the art of stone-cutting—obtaining the projections, templets and directing instruments for the individual stones in the various forms of structures, and the construction of models of the same.

Text-book—Warren's Stone-Cutting, with lectures.

(Junior, third term, once a week, with afternoon exercises.)

6. FRAMED STRUCTURES.—This course, designed alike for students in Mining and Civil Engineering, treats of general methods of determining stresses in such structures as single-span bridges, roof trusses, towers, derricks, etc., and of the design of individual members—post, beams and rods to carry predetermined stresses or loads. The suspended cable tramway receives practical treatment. The student is required to work out the stresses in one structure or more of each kind under a specified loading.

In the afternoons the Senior classmen may be occasionally required to direct and check the field exer-

cises of the Sophomore or Junior classes; otherwise the assigned afternoons will be spent in the solution of problems in graphic statics, working out details in structural iron work, estimation of quantities, weights, etc. (Senior, first term, five times a week, with afternoon work.)

7. **HYDRAULICS.**—The study of practical applications of the laws of hydrostatics, measurement and storage of water, flow through pipes and canals, design of pipe lines, and the theory of the various classes of hydraulic motors.

The afternoons are given to the design of such structures as the student is now competent to understand, and to work on a thesis, which should be commenced during this term. (Senior, second term, five times a week, with afternoon work.)

Text-book.—Merriman's Hydraulics.

8. **PRIME MOVERS AND POWER TRANSMISSION.**—The student receives such instruction as is deemed essential to Civil and Mining Engineers. Power transmission by steam, compressed air, cable, and water, are studied theoretically, and details of many plants examined as presented in the current engineering journals. (Senior, third term, three times a week.)

9. **BRIDGE ENGINEERING; SANITARY ENGINEERING.**—Students in Civil Engineering make a more thorough study of bridge construction than is accomplished in the first term. They also make a study of details of water supply and of sewerage of cities. At the same time the student is required to do much reading in the

engineering journals, descriptive of recently completed engineering structures, water works and sewerage systems. The assigned afternoons will be given to the preparation of a thesis. (Senior, third term, three times a week, with afternoon work.)

10. ASTRONOMY.—Determination of latitude, longitude and time, with reading and lectures in Descriptive Astronomy. (Senior, first term, three times a week. Required only in C. E. Course.)

11. SHOP WORK.—This is intended to familiarize the student with the practice and theory of wood-working as employed in engineering construction. The course consists of a series of graded exercises on the bench and lathe which involve the principles of joining, pattern making and construction. These are followed by the making of parts of engineering structures, or of complete small structures, from detail drawings prepared by the upper class-men in their engineering designs, or by the instructor.

Students are required to make a working drawing of each exercise before its execution in the shop.

(Freshman, twice a week throughout the year.)

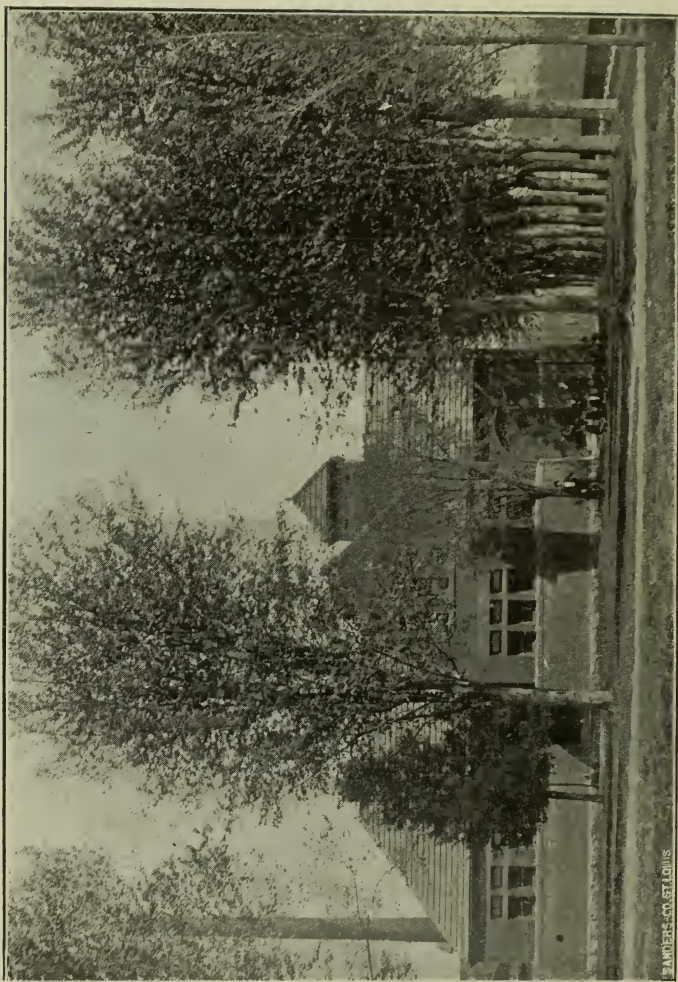
12. DRAWING.—Freshmen devote six hours per week to exercises in ruling, line-shading, etc., calculated to teach the use of drawing instruments, followed by a thorough drill in free-hand lettering, pencil sketching and drawing from models, scaled machine and architectural drawings from detail plates, tracing and blue-printing.

The work of the Sophomores consists of brush-shading in India ink, or plane, cylindrical, spherical, and other surfaces, followed by a graded series of machine drawings. The latter involve, first, making free-hand sketches of the details of machines, such as locomotive parallel rods, piston rods, crossheads, check valves, globe valves, lathe stocks, steam engine cylinders, valves, etc., with dimensions carefully indicated. From freehand sketches thus prepared, the student makes the assembled drawing to scale by use of drawing instruments, presenting as many views and sections as are necessary to make the drawing readable.

Considerable time is given to working exercises in Descriptive Geometry, and to preparing plats of surveys made in field practice.

The work outlined above continues throughout the year, in connection with the field practice. When students are not called out to field practice they spend their time at regular work in the drawing room.

In the Junior and the Senior years the draughting work is made to accompany and illustrate the class instruction, as outlined above, the work in each course being made to fit its particular needs. In the Senior year much of the draughting is in the execution of designs. These will take the form for Civil Engineers of the design of a bridge, roof truss, or other structure; for students in the other courses, of designs of mining machinery or metallurgical appliances, the latter being made under direction of the Professor of Mining and Metallurgy.



Mining and Metallurgical Laboratory.

WANDERS CO. ST. LOUIS

MINING AND METALLURGY.

PROF. DE KALB.

The work in this department is designed primarily with a view to the needs of students who have elected the specialties of Mine Engineering and Metallurgy. Stress is consequently laid upon practical methods throughout.

In the brief period of a course of collegiate education it is not possible to train a student to that skill in engineering and metallurgical operations which comes only from long experience in the field, but the best procedure, in accordance with modern practice, is taught in lecture room and laboratory, along with careful training in the application of fundamental principles, thus enabling the industrious to acquire proficiency in standard methods of Mining and Metallurgy, and to be able to deal independently with new or difficult problems which may present themselves in practice. Projets, memoirs, reports on visits of inspection to mines, metallurgical works, etc., with geological field work, are given due importance in the courses. An important feature of the instruction in this department consists in original experimental investigation in the practical concentration and metallurgical treatment of various ores in the Ore Dressing

and Metallurgical Laboratory, which contains a large plant of the most approved types of machines and other appliances for such purposes. In this portion of the course the student is required, as far as possible, to exercise independence of judgment, and to rely upon his own resources.

COURSE IN MINERALOGY AND GEOLOGY.

1. MINERALOGY.—Mathematical crystallography is taught as an introduction to the course, followed by determinative mineralogy. The most important metaliferous and rock-forming minerals are carefully studied, so that the student may become familiar with those of chief economic value, and with such as will concern him in ore-dressing and metallurgical practice and in lithology. Moses' Mineralogy and Blow-pipe Analysis is used as a text. (Junior, first and second terms, four hours per week each.)

2. LITHOLOGY.—The practical determination of rocks is treated as a continuation of mineralogy, students being allowed to use either Kemp's Handbook of Rocks, or Merrill's Rocks, Rock Weathering and Soils, as a text. (Junior, second term, part of time allotted to Mineralogy.)

3. DYNAMICAL GEOLOGY.—Le Conte's Elements of Geology is employed as a text, supplemented by lectures. The work is continued into the making of geological maps and sections. (Senior, first term, five hours per week, for half term.)

4. HISTORICAL GEOLOGY.—The same text as above is used, in conjunction with Williams' Geolog-

ical Biology, supplemented by practice in the determination of fossils with reference to the identification of geological horizons. (Senior, first term, five hours per week, for half term.)

5. **ECONOMICAL GEOLOGY.**—This is a series of lectures and recitations, dealing with the occurrence, distribution, and uses of ores, clays, stones, and other products of economical value from the different geological formations, including a thorough treatment of the characteristics and genesis of ore deposits. (Senior, third term, three hours per week.)

COURSE IN MINING.

6. **MINING.**—Lectures on Prospecting, Drilling and Well-boring, Exploitation, Methods of Extraction, Blasting, Transportation, Drainage, Ventilation, Lighting, Accidents, Hygiene, Mining Law, Sampling and Examination of Mines, and Quarrying extend through two terms. Practical problems, projets, and reports on visits of inspection, constitute features of the course. (Junior, second term, three hours per week; third term, five hours per week.)

7. **MINE SURVEYING.**—Some additional matter, such as methods adapted to special cases, with problems involving the principal conditions encountered in mine surveying, are included in the course in Mining. The subject of mine surveying constitutes part of the course in Engineering Geodesy in the Department of Engineering. (Junior. Part of Mining.)

8. **ORE DRESSING.**—A course of lectures, with practical problems, projets, etc., on the principles,

methods and leading mechanical appliances in use to-day for crushing, comminution, classification and concentration of all important ores, together with a thorough treatment of the preparation of coal, magnetic separation as applied to the enrichment and purification of iron ores, and to the elimination of iron from zinc and other ores. (Junior, first term, part of time assigned to laboratory work on Mondays; second term, four hours per week.)

9. MINING DESIGN.—Involves the designing, making out of specifications, and execution of working drawings of hoisting works, mine drainage and ventilation plants, transportation systems, laying out of mines, etc. May constitute a part of Thesis work. (Senior, first and second terms, two afternoons per week.)

10. ORE DRESSING LABORATORY.—Mondays throughout the first and third terms are accredited to work in practical tests in the crushing, classification and concentration of ores. As previously stated a part of this time in the first term is to be used for lectures preparatory to the practical demonstration in the laboratory. The object is to give the student experience in the more common methods of ore dressing treated in the theoretical discussions on this subject, and to afford him practice in the application of the principles learned in the class room to the production of useful results. The laboratory is fitted with crushers, rolls, a stamp battery, hydraulic classifiers, jig, Frue-vanner, percussion tables, etc. Detailed reports are required

on all work done. (Junior, first and third terms, Mondays.)

COURSE IN METALLURGY.

11. GENERAL METALLURGY.—A course of lectures and recitations, using Roberts-Austen's "Introduction to the Study of Metallurgy" as a basis. A thorough drilling is given in the application of chemistry, including thermo-chemistry, to metallurgy; fuels, natural and artificial, their application and efficiency; gas producers; utilization of by-products; furnaces, types and construction; chimneys; metallurgical processes; refractory materials; fluxes; slags, their characteristics and calculation; alloys, etc. Practice problems are assigned for solution throughout the course. (Junior, second term, five hours per week for half term.)

12. METALLURGY OF IRON AND STEEL, COPPER, LEAD, SILVER, GOLD, ZINC, NICKEL, ETC.—A course of lectures covering the methods of extraction of metals from their ores, in conformity with the best modern practice. Parallel reading in standard treatises, such as Peters on Copper Smelting, Hofman on Lead Smelting, Howes' Metallurgy of Steel, Metcalf's Steel, etc., is required, supplemented by laboratory practice. (Junior, third term, four hours per week, for half term. Senior, first and second terms, five hours per week.)

13. METALLURGICAL PROBLEMS.—This course is intended for further specialization on the side of metallurgy for students taking the course in Chemistry and Metallurgy. It involves problems in advanced metallurgy, heat distribution, calculation of charges, spe-

cial treatment of unusual or difficult ores, testing for process, designs of metallurgical plants, etc. (Senior, third term two hours per week.)

14. METALLURGICAL DESIGN.—The design and laying out of works, design of furnaces, with appropriate accessory machinery, etc., is taught in the draughting room. All work is original and is done from specifications. This may constitute a part of thesis work. (Senior, first term, three afternoons per week.)

15. METALLURGICAL LABORATORY.—Mondays throughout the academic year are given to practice in the treatment of metals, following parallel lines with the instruction by lectures. Experience is obtained in pyrometry, and determination of the calorific power of fuels; in tests of refractory materials; formation and characteristics of slags; testing for process; roasting of ores; smelting of lead, zinc and copper ores; milling of gold and silver ores; wet methods for extraction of copper, gold, and silver; electro-metallurgy, etc. The laboratory is well equipped with a water jacket blast furnace, roasting and other furnaces, and appliances for wet methods of treatment. Detailed reports are required upon all investigations and tests made. (Senior, first, second and third terms, Mondays.)

SUMMARY.

JUNIOR YEAR.

Mineralogy.	Ore Dressing.
Lithology.	Practical Ore Dressing.
Mining.	Principles of Metallurgy.
Mine Surveying.	Metallurgy of Iron, Steel, etc.

SENIOR YEAR.

Mining Design.	Metallurgy of Copper, Lead, Zinc, etc.
Dynamical Geology.	Metallurgical Problems.
Historical Geology.	Metallurgical Design.
Economic Geology.	Metallurgical Laboratory.
Ore Deposits.	

MODERN LANGUAGES.

The great quantity and worth of the technical literature in the French and German languages, added to their value as elements of liberal culture, makes at least a reading knowledge of them a highly desirable part of an Engineer's education. German is required in Course III, while the choice of French or German is permitted in Courses I and II.

The instruction in each language is designed to present the grammatical structure and the pronunciation of the tongue, to give some acquaintance with the masterpieces of its literature, and to confer such

facility in translation as will enable the student to read with ease the language in both its literary and its scientific uses.

GERMAN.

MR. WILKINS.

First Year.—Introductory lessons on pronunciation and German script, Keller's first year in German; Van Daell's Reader. Three times per week during first and second terms and five times per week in the third term.

Second Year.—Grammar and Composition, Schiller's "William Tell," Lessing's "Nathan der Weise," Goethe's "Hermann and Dorothea," and selections from other German authors.

The students in Scientific German read Hodges' Course in Scientific German. They are also required to do parallel reading in the current scientific magazines and standard scientific works.

FRENCH.

PROF. RICHARDS.

First Year.—Otto's Grammar, Whitney's Reader, "Choix de Contes" (Daudet).

Second Year.—Grammar (continued), original exercises, Racine's "Phedre," "Le Roman d'un Jeune Homme Pauvre" (Feuillet), "L'Abbe Constantin"

(Halevy), Herdler's Scientific French Reader, Marie's "Histoire des Sciences."

Parallel reading, outside of that done in class, will be assigned and will constitute part of the work on which the student is examined.

SPANISH.

PROF. DE KALB.

The growing demand for mining engineers and metallurgists in South and Central America, and in Mexico, where a knowledge of Spanish is almost an essential qualification, has been met by the establishment of a course in this language in the School of Mines. The natural, or conversational method is followed exclusively, with Ramsey's "Modern Spanish" as a reference grammar.

The object is to give the student not a knowledge of literary Spanish, but facility in the every-day speech of the people. The instruction includes a brief course in arithmetic, keeping of accounts, geometry, surveying and chemistry, given entirely in Spanish.

ACADEMIC COURSE.

The Academic Course is maintained in compliance with an Act of the Legislature of 1885. It is intended to include that fundamental general culture which should in part precede and in part accompany specifically technical training—to present a liberal discipline valuable in any career. To those contemplating a professional course, here or elsewhere, who have not laid this foundation; to teachers who desire better equipment for their work, and to any others whose wants it may suffice, this course is offered. As will be seen, studies are offered in English, History, Political Economy, Logic, Mathematics, German, French, and the Natural Sciences.

To enter upon this course a knowledge of Arithmetic and English Grammar is required.

For its completion a Diploma of Graduation in the course is conferred.

ACADEMIC COURSE OF STUDY.

FIRST YEAR.

FIRST TERM.	Times per week.	SECOND TERM.	Times per week.	THIRD TERM.	Times per week.
Elementary Algebra...	5	Elementary Algebra..	5	Elementary Algebra..	5
English— <i>Course I</i>	5	English— <i>Course I</i>	5	English— <i>Course I</i>	5
General History.....	5	General History.....	5	General History.....	5
Physiology	5	Physical Geography...	5	Physical Geography ..	5

SECOND YEAR.

Geometry.....	5	Geometry	5	Physics	5
Zoology.....	5	English— <i>Course II</i> ..	5	English— <i>Course II</i> ...	5
French or German.....	3	French or German.....	3	French or German.....	5
English History.....	5	English History	3	Psychology	3

THIRD YEAR.

Higher Algebra.....	5	Higher Algebra.....	5	Trigonometry	5
French or German.....	5	Logic.....	5	Civil Government.....	5
Elementary Chemistry.	4	Elective.....	5	Book-keeping (opt'l)..	3
Political Economy.....	5			Elective.....	5

ENGLISH.—In English two courses are offered, as follows:

Course I.—The principles of written discourse; Letter-writing, and Essay. Written exercises are required daily from the belief that painstaking practice

under proper supervision is the best, if not the only, means of acquiring facility in the use of good English. (Five times a week throughout the year.)

Text-book.—Hill's Revised Rhetoric.

Course II.—The History of English Literature from its beginning to the present. It is thought that a thorough knowledge of a few of our great writers is better than a slight knowledge of many. Students are, therefore, required to make a special study of the life, character, and masterpieces of Chaucer, Shakespeare, and such other representative authors as the time will admit. Every effort will be made to have the student acquire the ready use of good English, and to that end biographies, essays, reviews, criticisms, etc., will be required weekly. The Library is supplied with all the books of reference necessary to make this course both interesting and instructive. (Five times a week during the second and third terms.)

Text-book.—Nicoll's Landmarks of English Literature. Other books will be required as the classes progress.

MATHEMATICS.—A thorough knowledge of Elementary Algebra and Geometry is an essential requisite of a general education, as well as for entrance into higher scientific courses. During the first year students take Elementary Algebra, beginning with the fundamental operations and completing Quadratic Equations and the progressions. In the second year they have a thorough course in Elementary Geometry, Plane and Solid, with much practice in problem solv-

ing. In the third year they have a course in higher Algebra, including the study of Series, Indeterminate Coefficients, Logarithms, Theory of Equations, Determinants, etc., and complete Plane Trigonometry.

Text-books.—Algebra. First year—Wells' Academic Algebra. Second year—Wells' University Algebra, Wells' Plane and Solid Geometry, Wells' Trigonometry.

GENERAL HISTORY.—It is desirable that the student have as thorough knowledge as possible of Ancient, Mediaeval, and Modern History. For this reason the course here offered extends throughout the entire year. Special attention will be given to the growth and development of France, Germany and other modern nations of Europe. Students will be required to make constant use of the books of reference on History, found in the library. (Five times a week throughout the year.)

Text-book.—Fisher's History of the Nations.

ENGLISH HISTORY.—An effort will be made to present clearly and concisely the main facts in the History of England from the Roman Conquest to the present time. The growth of the political liberties of the people, the changes in social condition, and the advance in literature and arts will be shown as clearly as possible. (Five hours a week during first term, and two hours a week during second term.)

Text-book.—Montgomery's "Leading Facts of English History."

FRENCH OR GERMAN.—Students completing the Academic course are required to take two years of German or French. For information concerning the courses offered in these subjects see Modern Languages on pages 55-57 of this catalogue.

PHYSICS.—In this course the object constantly held in view is to present simply and plainly the fundamental truths of Natural Philosophy. The subjects of properties of matter, sound, light, heat, and electricity are introduced upon a scientific basis and are illustrated throughout the course by experiments. The department is supplied with apparatus of all kinds necessary for this purpose. (Five hours a week during third term.)

Text-book.—Elements of Physics by Carhart and Chute.

ELEMENTARY INORGANIC CHEMISTRY.—In this course careful detailed instruction is given in the fundamental principles of Chemistry, with a description of the most important elements and compounds, and the formation and solution of chemical equations. (Four hours a week during first term.)

PHYSIOLOGY.—It is aimed to make the instruction in this branch as thorough and practical as possible, and to lead the student to obey the injunction "Know Thyself." (Three hours a week during second term.)

Text-book.—Martin's Human Body.

PHYSICAL GEOGRAPHY.—The comprehensive nature of this study does not admit of its being treated in all its phases in the short time allotted to it.

The course will be principally descriptive, though the presentation of the scientific principles involved will be as thorough and complete as practicable, the design being to make this study serve as an introduction to the other natural sciences taken up later in the course. (Five hours a week during second and third terms.)

Text-book.—Appleton's Physical Geography.

CIVIL GOVERNMENT.—The text-book now in use (Young's Class Book) gives an analysis of the Constitution of the United States, presents a comparative view of the different State Governments, treats of County and Township organizations, and affords an acquaintance with such principles of law as are involved in ordinary business transactions. Special attention will be given to the Government of the State of Missouri. (Five hours a week during third term.)

POLITICAL ECONOMY.—All that is attempted in this subject, is to present in a plain and simple form the elementary principles of Political Economy. The main topics are treated, the fundamental principles studied and discussed, but no attempt is made to inculcate any particular economic doctrine. (Five hours a week during first term.)

Text-book.—Laughlin's Elements of Political Economy.

PSYCHOLOGY.—The aim in this study is to place before the student, in as simple and compact form as possible, a few of the leading facts connected with the human mind—its powers, its capabilities, its growth,

and some of the ways by which these powers may be strengthened and cultivated. (Three hours a week during third term.)

Text-book.—Hewett's Elements of Psychology.

LOGIC.—This study is intended to supplement that of Psychology. In the latter we have the analysis of the intellectual powers, in the former an investigation of the laws of correct reasoning. (Five hours a week during second term.)

Text-book.—Hill's Jevon's Logic.

BOOKKEEPING.—This study is not required, but will be taught upon the application of at least five students for instruction therein. The course comprises principally Double Entry. Various kinds of business are represented, and all the modern conveniences and auxiliaries are explained and used. The student is required to finish at least six different sets of books. Those who complete these before the end of the term will be furnished with abundant material for further practice.

SCHEDULE OF WORK—SESSION 1897=8.

On pages 66-67-68, will be found the schedule of work for the next session, 1897-8. It will be found, on examination, that this, in a few instances, does not agree with the Scheme of Courses, pp. 23-26. In making the change from the old system of two terms to the new of three terms, the division of the work by years has not always been precisely the same. Upper classmen, at the beginning of the next session, will, in some cases have had more work, in others, less, than under the arrangement which is to prevail in the future. Hence for the present, some deviation from the scheme intended to hold through the future is necessary in order to adjust it to existing conditions. For example, as the class in Calculus (Sophomore) will have had less time than provided in the new schedule, when they return as Juniors, they will have Calculus four times a week instead of three in the first term. In Metallurgy, on the contrary, there is a reduction of hours.

Zoology, Logic, Civil Government, and Bookkeeping are not set down in the schedule. The hours for these subjects will be arranged between instructor and students.

SCHEDULE FOR SESSION 1897-1898.

FIRST TERM.

PERIODS.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
I. 8.30-9.30.	F. Geometry. S. Analytical Geometry. J. Physics. Sr. Geometry. Ac. Political Economy. Ac. Physiology.	Geometry. Analytical Geometry. Physics. Geology. Political Economy. Physiology.	Geometry. Analytical Geometry. Physics. Geology. Political Economy. Physiology.	Geometry. Analytical Geometry. Physics. Geology. Political Economy. Physiology.	Geometry. Analytical Geometry. Geology. Political Economy. Physiology.
II. 9.30-10.30.	F. Chemistry. S. Surveying. J. French or German. Sr. Metallurgy. Ac. General History.	Chemistry. Calculus. Metallurgy. General History.	Chemistry. Surveying. French or German. Metallurgy. General History.	Chemistry. French or German. Metallurgy. General History.	Surveying. German. General History.
III. 10.30-11.30.	F. Astronomy. S. English— <i>Course I</i> . J. English— <i>Course I</i> . Sr. English— <i>Course I</i> . Ac. English— <i>Course I</i> .	French or German. Mineralogy. Thermo-Dynamics. English— <i>Course I</i> .	Astronomy. English— <i>Course I</i> .	French or German. Mineralogy. Thermo-Dynamics. English— <i>Course I</i> .	French or German. Astronomy. English— <i>Course I</i> .
IV. 11.30-12.30	F. Algebra. S. Inorganic Chemistry. J. Calculus. Sr. Framed Structures. Ac. English History.	Algebra. Inorganic Chemistry. Mineralogy. Framed Structures. English History.	Algebra. Inorganic Chemistry. Calculus. Framed Structures. English History.	Algebra. Inorganic Chemistry. Mineralogy. Framed Structures. English History.	Algebra. Inorganic Chemistry. Calculus. Framed Structures. English History.
	F. Drawing. M. E.—Field Prac- tice. S. C. E.—Field Prac- tice. C & M.—Chemical Laboratory. { M. E.—Chemical Laboratory. C. E.—Field Prac- tice. C. & M.—Chemical Laboratory. { M. E.—Designing. C. E.—Drawing and Field Practice. C. & M.—Chemical Laboratory.	Shop Practice. Chemical Laboratory. Chemical Laboratory. Chemical Laboratory. Field Practice. Chemical Laboratory. Designing. Drawing and Field Practice. Designing.	Drawing. Field Practice. Field Practice. Chemical Laboratory. Chemical Laboratory. Field Practice. Designing. Drawing and Field Practice. Designing.	Shop Practice. Chemical Laboratory. Chemical Laboratory. Chemical Laboratory. Physical Laboratory. Physical Laboratory. Physical Laboratory. Physical Laboratory. Physical Laboratory.	Chemical Laboratory. Field Practice. Field Practice. Chemical Laboratory. Physical Laboratory. Physical Laboratory. Physical Laboratory. Physical Laboratory. Physical Laboratory.
V. Afternoon					

SECOND TERM.

PERIODS.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
I. 8.30-9.30.	F. Geometry. S. French or German. J. Ore Dressing. Sr. Electrical Transmis- sion. Ac. General History.	G. Geometry. A. Analytical Geometry. O. Ore Dressing. E. Electrical Transmis- sion. G. General History.	G. Geometry. F. French or German. O. Ore Dressing. E. Electrical Transmis- sion. G. General History.	G. Geometry. A. Analytical Geometry. O. Ore Dressing. E. Electrical Transmis- sion. G. General History.	G. Geometry. F. French or German. E. Electrical Transmis- sion. G. General History.
II. 9.30-10.30.	F. English— <i>Course II.</i> S. Descriptive Geometry. J. Theoretic'l Chemistry. Sr. Metallurgy. Ac. Physical Geography.	E. English— <i>Course II.</i> S. Descriptive Geometry. J. Theoretic'l Chemistry. Sr. Metallurgy. Ac. Physical Geography.	E. English— <i>Course II.</i> S. Descriptive Geometry. J. Theoretic'l Chemistry. Sr. Metallurgy. Ac. Physical Geography.	E. English— <i>Course II.</i> S. Descriptive Geometry. J. Theoretic'l Chemistry. Sr. Metallurgy. Ac. Physical Geography.	E. English— <i>Course II.</i> S. Descriptive Geometry. J. Theoretic'l Chemistry. Sr. Metallurgy. Ac. Physical Geography.
III. 10.30-11.30.	F. Masonry Construct'n. S. English— <i>Course I.</i> Sr. Algebra. Ac. Applied Chemistry. Mining. Hydraulics. (C. & M.) Electro-Met- allurgy. English History.	M. Mineralogy. E. English— <i>Course I.</i> A. Algebra. Applied Chemistry. Mineralogy. Hydraulics. Electro-Metallurgy. English History.	M. Masonry Construct'n. E. English— <i>Course I.</i> A. Algebra. Applied Chemistry. Mineralogy. Hydraulics. Electro-Metallurgy. English History.	M. Mineralogy. E. English— <i>Course I.</i> A. Algebra. Applied Chemistry. Mineralogy. Hydraulics. Electro-Metallurgy. English History.	M. Masonry Construct'n. E. English— <i>Course I.</i> A. Algebra. Applied Chemistry. Mining. Hydraulics. Electro-Metallurgy.
IV. 11.30-12.30.	F. Drawing. S. { M. E. & C. E. — Chem- ical Laboratory. C. & M. — Chemical Laboratory. { M. E. — Physical Laboratory. C. E. — Physical Laboratory. C. & M. — Physical Laboratory.	S. { M. E. & C. E. — Chem- ical Laboratory. C. & M. — Chemical Laboratory. { M. E. — Physical Laboratory. C. E. — Physical Laboratory. C. & M. — Physical Laboratory.	S. { M. E. & C. E. — Chem- ical Laboratory. C. & M. — Chemical Laboratory. { M. E. — Physical Laboratory. C. E. — Physical Laboratory. C. & M. — Physical Laboratory.	S. { M. E. & C. E. — Chem- ical Laboratory. C. & M. — Chemical Laboratory. { M. E. — Physical Laboratory. C. E. — Physical Laboratory. C. & M. — Physical Laboratory.	S. { M. E. & C. E. — Chem- ical Laboratory. C. & M. — Chemical Laboratory. { M. E. — Physical Laboratory. C. E. — Physical Laboratory. C. & M. — Physical Laboratory.
V. Afternoon	Sr. { M. E. — Designing and Drawing. C. & M. — Chemical Laboratory.	Sr. { M. E. — Designing and Drawing. C. & M. — Chemical Laboratory.	Sr. { M. E. — Designing and Drawing. C. & M. — Chemical Laboratory.	Sr. { M. E. — Designing and Drawing. C. & M. — Chemical Laboratory.	Sr. { M. E. — Designing and Drawing. C. & M. — Chemical Laboratory.

THIRD TERM.

PERIODS.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
I. 8.30-9.30.	F. Physics. S. Differential Calculus. J. (C. E.) Lines of Communication. (M. E.) Mining.	Physics. Differential Calculus. Lines of Communication. Mining.	Physics. Differential Calculus. Lines of Communication. Mining.	Physics. Differential Calculus. Lines of Communication. Mining.	Physics. Differential Calculus. Lines of Communication. Mining.
	Sr. General History. Ac. English— <i>Course II.</i>	General History. English— <i>Course II.</i>	General History. English— <i>Course II.</i>	General History. English— <i>Course II.</i>	General History. English— <i>Course II.</i>
	F. Physics. J. Metallurgy. Sr. Bridge and Sanitary Engineering. Ac. Physical Geography.	Physics. Metallurgy. Power Transmission. Physical Geography.	Physics. Metallurgy. Bridge and Sanitary Engineering. Physical Geography.	Physics. Power Transmission. Physical Geography.	Physics. Metallurgy. Bridge and Sanitary Engineering. Physical Geography.
III. 10.30-11.30.	F. (C. & M.) Theoretical Chemistry. J. (M. E. & C. E.) Mechanics. Sr. Mining. Ac. Algebra.	Theoretical Chemistry. Mechanics. Mining. Algebra. Psychology.	Theoretical Chemistry. Mechanics. Mining. Algebra. Psychology.	Theoretical Chemistry. Mechanics. Mining. Algebra. Psychology.	Theoretical Chemistry. Mechanics. Mining. Algebra.
	F. Trigonometry. S. French or German. J. Organic Chemistry. Sr. Geology. Ac. (C. & M.) English— <i>Course I.</i>	Trigonometry. French or German. Organic Chemistry. Geology. English— <i>Course I.</i>	Trigonometry. French or German. Organic Chemistry. Electrical Transmission. Metallurgy Problems. English— <i>Course I.</i>	Trigonometry. French or German. Stereotomy. Geology. English— <i>Course I.</i>	Trigonometry. French or German. Organic Chemistry. Power Transmission. Metallurgy Problems. English— <i>Course I.</i>
	F. Chemical Laboratory. (M. E. — Field Practice. S. C. E. — Field Practice. C. & M.—Chemical Laboratory.	Shop Practice. Chemical Laboratory. Field Practice. Chemical Laboratory.	Drawing. Chemical Laboratory. Field Practice. Chemical Laboratory.	Shop Practice. Chemical Laboratory. Field Practice. Chemical Laboratory.	Drawing. Chemical Laboratory. Chemical Laboratory.
V. Afternoon	F. C. E.—Drawing and Field Practice. J. C. E.—Drawing and Field Practice. C. & M.—Chemical Laboratory. M. E.—Thesis. C. E.—Thesis. C. & M.—Chemical Laboratory and	Drawing and Field Practice. Drawing and Field Practice. Chemical Laboratory. Thesis. Thesis. Chemical Laboratory and Thesis.	Drawing and Field Practice. Thesis. Thesis. Chemical Laboratory and Thesis.	Physical Laboratory. Physical Laboratory. Physical Laboratory. Thesis. Thesis. Chemical Laboratory and Thesis.	Physical Laboratory. Physical Laboratory. Physical Laboratory. Thesis. Thesis. Physical Laboratory and Thesis.

GROUND, BUILDINGS AND EQUIPMENT.

The grounds of the School of Mines are situated in the highest part of the town of Rolla, and are somewhat over twenty acres in extent. The recent purchase of the lot intervening between the Campus proper and the "Park" has united the holdings of the school into a single continuous tract. The buildings, which are all substantial brick structures, are: The Main Building, the Chemical Laboratory, the Mess Club House, and the Mining and Metallurgical Laboratory.

Important improvements have been recently made. The whole campus has been graded and sown in grass. A low stone wall, surmounted by an iron fence, has been constructed about the southern and eastern sides of the campus. New walks have been laid, and some new trees set out. The appearance of the grounds is a vast improvement on what would be inferred from the frontispiece to this catalogue. The old furnaces in the basement of the main building have been removed, and in their place has been installed a steam heating plant, which warms both the main building and the Metallurgical Laboratory. This takes steam from the two 35 horse-power boilers already in connection with the ore-dressing laboratory. By this economical arrangement steam for heating is kept up continually during the cold weather, and is drawn when needed to run both the large engine which operates the machinery in the mill and the small en-

gine in the basement of the main building, which runs the dynamos and lathes. In one of the basement apartments, formerly used for storage, a toilet room with lavatory and closets has been arranged. Water for this and other purposes is furnished from two compressed air tanks located in the basement, which are supplied by means of a windmill from a bored well, 180 feet deep.

ENGINEERING EQUIPMENT.



The equipment for Field Practice includes a Heller and Brightly transit with solar attachments; a Gurley Construction transit; a Plane table with stadia attachments; a Gurley Y Level; a Buff and Berger Y Level;

a Gurley Solar Compass; a Gurley Vernier Compass; two Sextants; a Lock Level, with the necessary Level Rods, Chains, etc. It is expected to add to this equipment during the coming summer.

Tests of cement are made with a Riehle Bros.' U. S. Standard Cement Testing machine. A Steam Calorimeter, a Thompson's Steam Engine Indicator, and a Dynamometer are used in the instruction in Steam Engineering.

The shop contains a Steam Engine, Metal Lathe, Wood Lathes, Benches for wood-work, and individual sets of hand tools.

PHYSICAL LABORATORY.

The Physical Laboratory occupies three rooms in the main building and is well supplied with standard apparatus. Additions are constantly being made to its equipment.

The Dynamo Laboratory occupies a large room in the basement of the same building. It contains among other apparatus, a 60-light direct current dynamo, a Westinghouse Alternator and Transformer and standard measuring instruments, both for direct and alternate current measurement. An engine and boiler are included in the equipment; also the necessary apparatus such as indicators, calorimeters, etc., for complete engine and boiler tests. The work is so arranged

that students become familiar with the handling of apparatus such as is used in practical work.

A workshop, equipped with the necessary appliances for wood and metal working, is connected with the laboratory and gives students an opportunity to make whatever apparatus they may need in the pursuit of any original investigation.

EQUIPMENT IN MINERALOGY AND GEOLOGY.

This includes a representative collection of 1000 specimens of minerals for class use; 200 specimens of rocks; 200 specimens of typical fossils; a large collection illustrating metallurgical processes; a collection of 500 specimens of ore from the World's Fair. To this, additions are being made from time to time.

This material has been greatly augmented by the acquisition in 1895 of the entire Missouri Mineral Exhibit collected for display at the World's Fair at Chicago, which by act of the State Legislature became part of the permanent equipment of the School of Mines. This collection contains 3529 specimens representing the mineral wealth of Missouri, consisting of ores of lead, zinc, iron, and copper, coal, clays of many sorts, and building stones. Many of the specimens are of extraordinary size and rare beauty. The minerals occurring as gangue with the metalliferous

deposits of the State are also well represented. Altogether it is an unusually valuable assemblage of geologic products of economic importance.

A full set of instruments for geological surveys constitutes a portion of the outfit of this department.

MINING AND METALLURGICAL LABORATORY.

The special building for the Department of Mining and Metallurgy, finished in 1895, is equipped with the necessary appliances for a practical course in ore concentration, roasting and reduction.

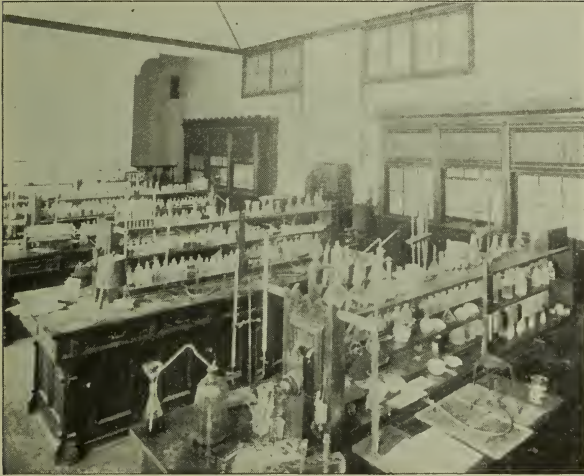
The building consists of two distinct portions, one containing a chemical and a mineralogical laboratory, lecture room, reference library, draughting room, petrographical laboratory, blue print room, etc.; the other comprising a large mill room, an engine room, and a boiler room. The mill room is equipped with first-class modern machinery, of standard sizes, for crushing and concentration of ores, the plant containing a Dodge rock breaker, Cornish rolls, stamp battery with automatic feeder, Calumet hydraulic classifier, inlet discharge separator, Hartz jig, Spitzkasten, Parsons-Rittinger percussion tables, Frue vanner, grinding and amalgamating pan and settler, with settling boxes. In addition to these, working models of different types of concentrators have been made by students of the

School of Mines and contributed to its outfit. The reduction plant consists of a reverberatory roasting furnace, and 20 inch water jacket cupola furnace, with Root blower, for lead and copper ores. There are also assay and cupellation furnaces, and before the beginning of next term it is hoped that a zinc distillation furnace will have been erected. A barrel chlorination outfit has also been added during the past year, and the Ingersoll-Sergeant Drill Co. has presented the school with one of its steam and compressed air drills, with which the classes in mining are given experience in drilling. The power for the above plant is derived from a 50 H. P. automatic engine, taking steam from two 35 H. P. tubular boilers.

By means of this excellent equipment students receive practical instruction in the crushing and concentration of various ores, and in the metallurgical treatment of ores of lead, zinc, copper, gold, and silver.

There is much space remaining in the mill room which will be filled with additional appliances as rapidly as funds permit.

CHEMICAL LABORATORY.



The Chemical Laboratory is a substantial, well-lighted brick building, devoted entirely to the work of the chemical department. It contains a qualitative laboratory, quantitative laboratory, assay laboratory, lecture room, preparation room, balance room, stock room, private laboratory, and office.

The qualitative laboratory is 47x25 feet and has working places for twenty-eight students at a time. The cupboards and drawers are duplicated throughout so that double that number can be accommodated. This laboratory is also used by workers in General Chemistry.

The quantitative laboratory is 47x27 feet and has working places for twenty-six men. Its accommodations are excellent.

All working places in both laboratories are fastened by combination locks so that each student may be held responsible for his own apparatus.

The assay laboratory has recently been renovated. It has a concrete floor and is practically fire-proof. There are four muffle furnaces, carrying muffles 16x19 inches. These are encased in galvanized iron hoods connecting with ventilating flues, which carry off lead fumes and superfluous heat. The equipment also includes one small gasoline Hoskins' furnace, carrying 8x4½ inch muffle, one Hoskins' furnace with 15x9 inch muffle, and one wind furnace. The laboratory is conveniently fitted with sink, cupboards, balances and apparatus for crushing and sifting.

The balance-room is provided with eight analytical and five assay balances. The general equipment is excellent and is being constantly increased.

LIBRARY.



The Library contains 3,500 volumes. Good collections of works upon Engineering, Mathematics, Chemistry, Physics, Mining and Metallurgy, afforded to students in these departments an opportunity to pursue an extended course of reading in connection with their class work. The Library also contains the standard works in English and American Poetry, Fiction, Biography, and History. It is well provided with encyclopaedias and works for general reference. The Library is open and in charge of the Librarian from 8:30 a. m. to 12:30 p. m., and from 2 to 4 p. m. During these hours books may be taken out and the Library room used for reading and study. The following periodicals

for the current year are found on the reading tables of the Library:

American Geologist,	Journal of American Chemical Society,
American Chemical Journal,	Journal of Franklin Institute,
Annales de Chimie et de Physique,	Journal of Iron and Steel Institute,
Annals of Mathematics,	Ladies' Home Journal,
Century,	Life,
Chemical News,	Literary Digest,
Colliery Engineer,	McClure's Magazine,
Cosmopolitan,	Mining and Scientific Press,
Electric World,	Nation,
Electrician (London),	North American Review,
Engineering (London),	Popular Science Monthly,
Engineering Magazine,	Power,
Engineering News,	Scribner's Magazine,
Engineering and Mining Journal,	Technology Quarterly,
Forum,	Transactions American Society of Civil Engineers,
Harper's Monthly,	Wiedemann's Annalen,
Harper's Weekly,	Zeitschrift für analytische Chemie.
Illustrated London News,	

MESS CLUB HOUSE.

The "Club House," a three-story brick building of pleasing architecture, which has been in use six years, has recently been thoroughly repaired, cleaned, papered, and put into the best of order. It is at present conducted as a dormitory, solely, students lodging there and taking their meals at neighboring boarding-houses. Each room contains the simple necessary furniture. Students furnish their own bedding and towels, and pay *pro rata* for the fuel consumed. Table board

may be had in the vicinity for from \$9.50 to \$11.00 per month. No charge is made for room rent, but in order to engage quarters each applicant must deposit with the Treasurer of the School of Mines five dollars (\$5.00), which shall be held as a contingent fund to pay for any damages for which the depositor may be responsible—the unconsumed portion of such fund being returned to him at the end of the session. Choice of rooms will be permitted in the order in which such deposits are received. It is intended next year to have meals as well as lodgings furnished in the Club House, it being put into the hands of a competent manager and caterer. Board, fuel, light and care of room are to cost not over \$13.00 a month.

As the accommodations are limited, early application is advised.

GENERAL INFORMATION.

EXPENSES.

The School of Mines is endowed and supported by the State for the benefit of its sons and daughters, and seeks to offer to them its instruction at the lowest possible cost. It is believed that nowhere else in this country can equal advantages be had at such slight expense. The only fixed general charges are an entrance fee of \$10.00 payable whenever the student may enter, and a library fee of \$2.00 a term, payable at the beginning of each term, or \$4.00 for the whole year. *There*

is no charge for tuition. Freshmen make a contingent deposit of \$5.00, higher classmen of \$10.00, upon entrance to pay for apparatus which they may damage or destroy. Costly apparatus is entrusted to them for use, and it is imperative that they have some incentive to use it carefully. Students beyond the Freshman year in the Chemical Laboratory pay also for gas, for fuel consumed in assaying, and for chemicals actually used. To make this last item as small as possible, the School buys such supplies at wholesale rates and issues them to students as they are needed at corresponding prices. To cover bills arising from these sources students in Qualitative Analysis deposit upon entrance \$10.00; those in Quantitative Analysis \$15.00. These deposits must be renewed if at any time exhausted; at the end of the session whatever sum may remain to the credit of the depositor in any of these funds is returned to him.

No distinction in admission nor in charges is made between residents of this state and of other states and countries.

Board, including lodging, meals, fuel and lights, may be had in the Mess Club for from \$11.50 to \$13.00 a month; in private families for from \$13.00 to \$15.00; at the hotels for from \$15.00 to \$20.00. Washing costs from \$1 to \$1.50 per month.

Subjoined is an estimate of the necessary expenses for the school year:—

	Moderate.	Ample.
Entrance and Library Fees	\$ 14 00	\$ 14 00
Books, Stationery, Chemicals, Contingent	19 00	50 00
Board, Fuel, Lights, Washing	117 00	144 00
Total	\$150 00	\$208 00

EXEMPTION FROM FEES.

Teachers in Public Schools of Missouri will, *during the latter half of the session*, be admitted without the payment of any entrance fee. This privilege is granted to enable teachers, after their schools are closed, to utilize their time in self-improvement. The school looks for its reward to the eventual improvement of its entering students.

VACATIONS.

The college year, consisting of thirty-eight weeks, exclusive of the Christmas holidays, is divided into three terms as explained on page 21. The Christmas holidays cover ten days and intervene between the first and the second term. There is no interruption of work between the second and the third term. Thanksgiving Day and Washington's Birthday are observed as single holidays. In the month of April there occurs a variation of work which may be regarded as a partial holiday. A week is set aside in which there will be no recitations, but students will devote themselves to consecutive work in the various laboratories, the drawing-room, or the shop, to field excursions for practice in engineering or geology, or to visits of inspection

to mines and metallurgical works. The precise date is left to be determined later so that if possible, a period may be chosen when the weather is suitable to out-door work. During the current session, the Seniors in Mining Engineering were employed in the Metallurgical Laboratory; the Juniors divided their time between the ore-dressing and the assaying laboratories; the Seniors in Civil Engineering and the Sophomores made a trip to Arlington, on the Gasconade River (12 miles distant), where they established a base line, effected a system of triangulation, and made a topographical reconnoissance, using their notes on their return to make an accurate map of the terrain thus surveyed; the Freshmen spent the time in drawing, shop-work and laboratory work in General Chemistry.

EXAMINATIONS.

In most of the classes there are daily oral examinations. Occasional written examinations on portions of subjects are held. These are designed to give the students a review, to practice him in the writing of examination papers, and to enlighten the professor as to the progress of his class. From these sources the monthly grades are determined. At the end of each term searching written examinations on all the matter studied during the term are held. The marks gotten in these, combined with the average monthly grades, determine the "term grades." To pass, 75 per cent is required.

REGULATIONS GOVERNING EXAMINATIONS, DEFICIENCIES, ETC.

I. Special examinations in any study will be granted at the beginning of any term to new students seeking advanced standing, or to former students who may have failed to reach the passing grade in any subject, but whose average class grade in that study is as high as 50 per cent.

II. Students whose average class grade in any study is below 50 per cent will be required again to attend the class covering that subject.

III. No student may receive promotion from one class to the next higher class who is in arrears in work aggregating more than five hours of class exercises per week for the academic year.

IV. No student in a regular course will be allowed to take any work of the Junior year until he has completed all the requirements of the Freshman, nor to take any work of the Senior year until he has completed all the requirements of the Sophomore year.

V. A student who absents himself from the regular examination in any subject which he may be pursuing, will not be granted an examination in such subject except under condition of having pursued the same study with the next following class, unless such absence shall have been excused by the Faculty.

MONTHLY REPORTS.

Monthly reports are regularly sent to the parent or guardian of each student, showing the student's grade in scholarship for the month and giving such other information in regard to his progress, attendance, etc., as may be thought of interest. The attention of parents and guardians is particularly called to these reports. The Director is ready at any time to correspond and advise with them concerning the student's class-work and conduct.

DISCIPLINE.

The School of Mines has but two general rules:
1. Be a gentleman (or a lady). 2. Work. Students

who violate either of these are requested to leave. Flagrant violations of them are punished by suspension or expulsion, according to the nature of the offense.

STUDENTS' SOCIETIES.

A general literary and scientific society, composed of both students and professors, meets fortnightly to discuss topics of contemporary interest, important current events, scientific inventions and progress, etc. Lectures before this society are occasionally given by the professors and others. Advanced students in Chemistry have a "Journal Club" which devotes itself to the critical study of chemical articles of interest in the various publications relating to chemistry with which the Library is supplied.

ATHLETICS.

The School encourages rational athletics. Occasional privileges are granted to athletic teams, but prolonged absences from work are not permitted.

Through the liberality of the Curators an athletic field has been inclosed and graded for the benefit of the students. It furnishes ample space for base-ball, foot-ball and lawn tennis. An Athletic Association exists among the students, and foot-ball and base-ball teams are in organization. There are several excellent lawn-tennis courts, which the students use.

ALUMNI ASSOCIATION.

An Association of Alumni of the School of Mines has been formed. Dr. Floyd Davis, C. E., M. E., Ph. D.,

of Des Moines, Iowa, is President, and Miss Sallie Millard, B. S., of Carthage, Mo., is Secretary. The wide dispersion of the graduates of the School, who in the last few years have ranged from Boston to San Francisco and from Alaska to Tehuantepec, with representatives in South America and South Africa, renders their assemblage difficult, but it is intended that at each Commencement as many as possible shall meet in Rolla to renew associations with each other and with their Alma Mater.

DONATIONS.

The School of Mines desires to offer thanks for the following donations:

The Ingersoll-Sergeant Drill Co., of New York, one steam and compressed air drill.

Mr. Aug. Nasse, of St. Louis, mineral specimens.

Mr. W. Rowland Cox, Aspen, Colorado, blue prints of mining machinery.

Mr. J. E. Kirkham, Kansas City, Mo., blue prints of bridge details and roof trusses.

Hon. D. R. Francis, Secretary of the Interior, historical map.

Hons. J. D. Hubbard and R. P. Bland, numerous government publications.

Prof. C. R. Keyes, State Geologist, Reports of Geological Survey.

EXAMINATION OF MINERAL SPECIMENS.

The School receives a great many inquiries concerning the examination of specimens. It is deemed ad-

visible to state in the catalogue its usage in this matter. The School desires to aid the miners and prospectors of the state, has aided and is aiding them. If, however, it were announced that all specimens sent in would be analyzed free of charge, there would be a deluge of rocks, usually worthless, that would consume all the time of officers whose chief duty is instruction. Hence, the following rule is adopted: Of any specimen found on Missouri soil and sent, carriage paid, the School will make, free of charge, such preliminary examination as shall be sufficient to disclose its character and whether or not it possesses probable value. The sender is informed of the result and whether an assay seems advisable. If he chooses to have an assay made, a small fee—usually \$1.50 per assay—is charged.

DEGREES.

UNTITLED DEGREES.

1. A Certificate of Proficiency is conferred on one who has attained the required standard in any of the following special courses: Assaying and Technical Analysis, Surveying, Electricity, Geology and Mineralogy, Inorganic Chemistry and Mathematics (through the Calculus).

2. A Diploma of Graduation is conferred on one who has attained the required standard in any of the following departments: Mathematics, Physics, Analytical Chemistry, Engineering, Mining and Metallurgy and the Academic Course.

DEGREES WITH TITLES.

1. The degree of Bachelor of Science in Mining Engineering, Bachelor of Science in Civil Engineering or Bachelor of Science in Chemistry and Metallurgy, will be conferred on one who has attained the required standard on all the subjects of instruction in Course I, Course II, or Course III.

2. The further degree of Engineer of Mines, Civil Engineer or Metallurgical Engineer, will be conferred on one who, having previously graduated in Course I, Course II, or Course III, has completed satisfactorily a year's post-graduate work in residence here, or who has had professional experience in a responsible position for not less than two years.

In the latter case, the applicant must present a statement of his career since graduation and a thesis, which may be a record of some work in which he has been actually engaged.

COMMENCEMENT.

The annual Commencement exercises are held in the Assembly Room on the morning of the final day of the session, the second or third Wednesday in June. The exercises consist of the conferring of certificates, diplomas and degrees, the reading, when advisable, by the graduates, of abstracts of their theses, and an address by some prominent speaker. At the last Commencement addresses were delivered by Hon. R. B. Oliver, of Cape Girardeau, Mo., and Dr. Floyd Davis, of Des Moines, Iowa.

At the last Commencement, June 11th, 1896, were awarded the following

CERTIFICATES OF PROFICIENCY.

ASSAYING AND TECH. ANALYSIS.

Cameron, J. S.	Dean, G. W.	Gottschalk, V. H.
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MATHEMATICS.

Anderson, P. B.	Cameron, J. S.	Kersting, F.
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SURVEYING.

Anderson, P. B.	Cameron, J. S.	Kersting, F.
Lockridge, G. W.	Terrell, A. D.	

DIPLOMAS OF GRADUATION IN ACADEMIC COURSE.

Burgher, Sylvia.	Richardson, Grace Sarepta.	Via, Jessie Miller.
	Wilkins, Elinor Matilda.	

DEGREES.

Bachelor of Science (in Mining Engineering),

MARTIN, WALTER G.

Mining Engineer,

GROVE, CLAUDE D., B. S., '94.

INQUIRIES.

Questions concerning any particular department may be addressed to the professor in charge of it; all general inquiries, requests for catalogues, etc., should be made to

W. B. RICHARDS, Director,
Rolla, Mo.

Catalogue of Students.

SENIOR CLASS.

Anderson, Perry Barton.....	Neosho.	
Cameron, John Simpson.....	Krebs, I. T.	
Dean, George Walter.....	Elk Prairie.	
Eardley, Albert Edward	Carrizo Springs, Tex.	
Kersting, Felix.....	St Louis.	
Rogers, John.....	Bevier.	
Spengler, Albert.....	Kansas City.	
Torrence, Leslie Clay.....	Pocahontas.	8

JUNIOR CLASS.

Barker, Ralph	Chicago, Ill.	
Beyer, Frank Bean	Philadelphia, Pa.	
Donnelly, Arthur Thomas.....	Rolla.	
Gottschalk, Victor Hugo.....	St. Louis.	
Hendricks, James Otto.....	Bolivar.	
Larsh, Paul Armstrong.....	Nebraska City, Neb.	
Lockridge, George William.....	Jamesport.	
Smith, George Washington.....	Rockford, Ill.	
Terrell, Arthur Davis.....	Holden.	
Torrence, Euart Carl.....	Pocahontas.	10

SOPHOMORE CLASS.

Bowman, Wade Walbridge.....	Lebanon.	
Cardenas, Francisco.....	Monterey, Mex.	
Chamberlain, Santiago.....	Monterey, Mex.	
Clark, George Clough.....	Leadville, Colo.	
Coe, Herbert William.....	Kansas City.	
Fernandez, Abraham.....	Monterey, Mex.	
Hatchett, Roger Hanson.....	New Florence.	
Illinski, Alexis Xavier.....	East St. Louis, Ill.	
Jamison, Claude Eagan.....	Rolla.	
Leivy, Pasha Benjamin.....	East St. Louis, Ill.	
Lund, Albert Edward.....	White Oaks, N. M.	
Perkins, Edwin Thompson.....	Kansas City.	
Perkins, Frederick Hough.....	Kansas City.	
Rogers, Austin Flint.....	Kansas City.	

Rogers, Herbert Fordyce.	Holden.	
Schulze, Hermann Otto ..	Vetschau, Germany.	
Soest, Walter Ernest.	Rolla.	
Tayman, Francis Joseph.	Lebanon.	
Underwood, Jerrold Roscoe ..	Kansas City.	
Villareal, Francisco.	Monterey, Mex.	20

FRESHMAN CLASS.

Bantley, Charles Hermann.	Lebanon.	
Baughman, Claude Griffe.	Rolla.	
Bland, Harry Osmond.	Rolla.	
Cooney, Robert Emmett ..	Ft. Smith, Ark.	
Cope, Ralph Palmer.	Kingston.	
Diffenderffer, John Laughton.	Lebanon.	
Elizondo, Julian ..	Monterey, Mex.	
Fach, Charles Albert.	St. Louis.	
Fayant, Clarence Howell.	Lebanon.	
Fraizer, Isaac Peter.	Rolla.	
Garcia, John Adrian.	St. Louis.	
Graeser, Henry Jacob ..	Stratmann.	
Herndon, James Archibald.	Lebanon.	
Hull, John Stanley.	Hamilton, Ohio.	
Jurden, Ralph Louis.	Holden.	
Koeberlin, Frederick Richard.	St. Louis.	
McComb, Ernest Hubert.	Lebanon.	
McCormick, William Roland.	Gunnison, Colo.	
McLane, Robert.	Oak Ridge.	
Mitchell, Phelps.	Rolla.	
Niles, Claude Asa ..	Rolla.	
Ollis, Frederick Weld.	Springfield.	
Phariss, Bertie Lewis.	Rolla.	
Powell, Walbridge Henry ..	Rolla.	
Regel, Ferdinand Hermann.	St. Louis.	
Taylor, Howard Joshua.	Lentner.	
Tetley, William Robert.	Farmington.	
Trotter, James.	Carrollton.	
Walker, Dix.	Oak Ridge.	
Weigel, William Melvin.	Memphis, Tenn.	
Wesseler, William Julius.	St. Louis.	31

SPECIAL STUDENTS.

Beall, Sarah.....	Kansas City.
Brown, Oliver W.....	Indianapolis, Ind.
(B. S. Earlham, A. M., Ind. Univ.)	
Chamberlain, Louis John....	Rolla.
Fort, Edward Long.....	Rolla.
Green, Albert Edgar.....	Chicago, Ill.
Groves, Virgil Pitzer.....	Springfield.
Hanley, John Alexander, Jr.....	Clayton.
Herzinger, John Adam.....	Lake City, Colo.
Hutchison, David Love.....	Florence, Colo.
(C. E. Iowa Agricultural College.)	
Hutchison, James A....	Ames, Iowa.
Kirby, R. F.....	Deadwood, S. D.
Kerr, William Christian....	St. Louis.
Knapp, Theron Lorenzo.....	Rolla.
Knight, Stanley Marion.....	Chicago, Ill.
Mitchell, Gordon Foote.....	Keithsburg, Ill.
Norman, Samuel Jacob.....	St. Louis.
Otter, Jerome Paul.....	Jennings, Kan.
(A. B. Holy Ghost College.)	
Paterson, Harry Thomas.....	Newport, Ky.
Phillips, Daniel M.....	Capioma, Kan.
Schulze, Victor Eugen.....	Vetschau, Germany.
Shimin, Edward Wheeler.....	Rolla.
Williams, Samuel Daugherty.....	Jackson.
Wilkins, Elinor Matilda.....	Rolla.

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ACADEMIC STUDENTS.

Cooper, Charles Noble.....	Viessman.
Curtis, Leslie Virgil.....	Lecoma.
Ferrell, Houston Everett.....	Lois.
Gonzalez, Eduardo.....	Monterey, Mex.
Harrison, Edmund Carroll.....	Rolla.
Holt, John Jurden.....	St. Louis.
Johnson, William.....	Rolla.
Millard, Anna Reed.....	Rolla.
Rolufs, Rulof Theodore.....	Vest.
Shaw, Hiram Miller.....	Rolla.
Southgate, Don.....	Rolla.
Westcott, Edith May.....	Westcott.

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SUMMARIES.

I. By Classes:

Seniors.....	8
Juniors.....	10
Sophomores.....	20
Freshmen.....	31
Specials	23
Academic.....	12
Total.....	104

II. By States, Territories and Foreign Countries:

Missouri.....	71
Illinois.....	7
Colorado	4
Kansas....	2
Arkansas.....	1
Indiana.....	1
Iowa	1
Kentucky.....	1
Tennessee.....	1
Nebraska.....	1
Ohio.....	1
Pennsylvania.....	1
South Dakota.....	1
Texas	1
Indian Territory.....	1
New Mexico.....	1
Mexico.....	6
Germany.....	2
Total	104

GRADUATES.

The following is a list of the graduates of the school, with some of the positions held since graduation, and their occupations and addresses according to latest information attainable. It is earnestly requested that Alumni will notify the Director of any change in location in time for the next catalogue.

1874.

Gustavus A. Duncan, C. E.—Assayer and Mine Superintendent, Colorado, '74-'82; Expert for Emery Bros., Minnesota; now Mine Owner and Examiner, Boston, Mass.

*John Holt Gill, C. E.

John W. Pack, M. E.—Assayer Boulder Smelter, Boulder, Colo., '74-'76; Assayer and Refiner, Montana and California, '76-'85; now Assayer U. S. Mint, San Francisco, Cal.

1875.

*Francis J. Deegan, C. E.—Engineer Louisville, New Orleans and Texas Railway.

Almon W. Hare, M. E.—Chemist and Assayer, Aspen, Colo.

1876.

Cyrus H. Emerson, C. E.—Denison, Tex.

Oscar E. Garvens, M. E.—With Vandalia R. R., East St. Louis, Ill.

* Dead.

*John D. Greason, M. E.—Assistant Engineer and Right of Way Agent, D. M. and A. R. R., killed by Indians, 1896.

John E. McGrath, C. E.—Assistant U. S. Coast and Geodetic Survey, Washington, D. C. (recently in charge of Government Surveys in Alaska).

William C. Minger, M. E.—Assayer and Chemist in Colorado and, for one year, in Mexico, '76-93; now Analytical Chemist, Denver Colo.

1877.

A. H. Ohmann-Dumesnil, M. E.—M. D., St. Louis Medical College, '80; Professor of Dermatology, Marion-Sims Medical College; Physician; Editor of St. Louis *Medical and Surgical Journal*; Author of several medical books and a large number of monographs.

Thomas H. Milsaps, C. E.

James A. Pack, M. E.—Assayer and Chemist, Butte, Montana; General Manager Black Pine Mining Co.; Mine Engineer and Mill Superintendent, De Lamar Mining Co., De Lamar, Idaho.

1878.

*Wilton R. Brown, M. E.—Assayer, Shakespeare Gold and Silver Mining Co., Shakespeare, New Mexico.

Wm. Y. Bean, C. E.—Engineer Missouri Pacific R. R.

*Lindsay L. Coppedge, C. E.—Engineer Missouri Pacific R. R.

* Dead.

Lee R. Grabill, M. E.—Assayer for Basic Mining Co., Rosita, Colo., '78-'82; Engineer for Gunnison Coal and Iron Co., Crested Butte, Colo., '83; since '83, Assistant Engineer in Government Work on Rivers and Harbors, Washington, D. C.

1879.

Rudolph C. Hoyer, C. E.—Draughtsman U. S. Engineers' Office, Memphis, Tenn.

Charles F. Winters, M. E.—Formerly Assayer in New Mexico; now Teller, Los Angeles National Bank, Los Angeles, Cal.

1880.

Arthur Carson, M. E.—Chemist and Assayer, Butte, Mont.

Lorin X. Smith, M. E., C. E.—Div. Engineer K. C., Ft. S. and Gulf R. R. and same, Denver and New Orleans R. R.; Metallurgist for Flagler Reduction Works; Mill Superintendent, Seina Gravel Co., Lake Valley, New Mexico; Assistant City Engineer, San Diego, Cal.; Mill Superintendent, Hidalgo M. and M. Co., Parral, Mexico; Assayer, E. & E. Co., Baker City, Oregon; Assayer for Tiger & Poorman, Burke, Idaho, Chemist and Superintendent, Pioneer Sampling Works, Wallace, Idaho; Superintendent and Mining Engineer Bi-Metallic and Granite Mt. Cos. Philipsburg, Montana; Chemist, Colorado Smelter, Butte, Montana; now mining at Cripple Creek, Colorado.

Edward B. Summers, C. E.—U. S. Topographical Assistant, '81-'85; R. R. Engineer, '85-88; U. S. River and Harbor Works, '88-'91; with King Iron Bridge Co., '91-'94; now draughtsman, Bridge Department, New York Central and Hudson River R. R.

Walter W. Wishon, M. E., Chief Chemist, Montana Ore Purchasing Co., Butte, Mont.

1882.

Herman Neff Van Devander, C. E.—With St. Louis and San Francisco R. R., '82-'83; Engineer, Anniston and Atlantic Ry., '83-'84; Secretary and Treasurer Southern Mining and Improvement Co.; President and Treasurer North Georgia Mining Co., Cedartown, Ga.

Frank W. Gibb, C. E., M. E.—Mining Engineer and Chemist, now Architect, Little Rock, Ark.

W. P. Painter, C. E.—Editor *Democrat*, Carrollton, Mo.

Beauregard Ross, M. E.—Postmaster, Cameron, Mo.

Ashnah B. Schrantz, C. E.—Engineer Union Pacific Railway.

1883.

Floyd Davis, C. E., M. E.—M. Sc., Adrian College; Ph. D., Miami University; Prof. of Chemistry, Va. Agricultural and Mechanical College, '83-'86; Student Johns Hopkins University, '86-'87; Prof. of Chemistry, Drake University, '87-'93; State Chemist of Iowa, '88-'93; Acting Prof. of Metallurgy, Wisconsin University, and Commissioner for Iowa to Paris Exposition, '89; Prof. of Chemistry and Toxicology,

Iowa College of Physicians and Surgeons, and Dean of Iowa College of Pharmacy, '91-'93; President New Mexico School of Mines, '93-'95; Author of several books and a number of scientific articles; now Analytical and Consulting Chemist, Des Moines, Ia.

1884.

Curtis Alexander, C. E., M. E.—Assistant Division Engineer Leavenworth, Northern and Southern Railway, '86-'87; Chemist for U. S. Antimony Co., '87-'88; Assayer and Chemist, Mexican Ore Co., Laredo, Tex.; Chief Assayer of Consolidated Kansas City Smelting and Refining Co., Argentine, Kansas.

William M. Claypool, C. E., M. E.—Chemist, Fairbank, Arizona; Manager, Arizona Ore Sampling Co., Prescott, Arizona.

Philip C. Gallagher, M. E.—Assayer and Chemist, Leadville, '84-'87; Superintendent Minnie Mine, Breckenridge, Colorado, '87-'88; Assayer, Aspen, Colorado; now at Leadville, Colo.

Arthur Neustreadter, M. E.—Office of Board of Public Improvements, St. Louis, Mo.; Supt. St. Genevieve Copper Works, St. Genevieve, Mo.; Chemist and Assayer, Butte, Montana.

Frank W. Wilson, C. E.—Draughtsman, Des Moines, Iowa, '84-'85; Transitman, C. R. I. & P. R. R., and C. B. & Q. R. R., '85-'86; Division Engineer, O. & R. V. Branch, U. P. R. R.; Transitman, St L. & San Francisco R. R., '87; Superintendent of Construction, Atlanta Bridge Co. '88-'89; Chief

Draughtsman, Milwaukee Bridge & Iron Works, '89-'90; Engineer, King Bridge Co., '90-'92; Assistant Engineer, Bridge Dept., N. Y. Central R. R.; Engineer of Bridges, in charge of all bridge work on N. Y. Central and leased lines, New York, N. Y.; now agent for Mining Machinery, Johannesburg, So. Africa.

1885.

*John R. D. Owen, M. E.—Assistant in Chemical Laboratory, Missouri School of Mines.

Philip R. Van Frank, M. E.—Transitman, U. S. River Commission, Little Rock, Ark.

Fremont W. Wilson, C. E.—Resident Engineer, St. Louis, K. C. and Colorado R. R., '86-'87; Resident Engineer, Mississippi and Bonne Terre R. R., '88-'89; Assistant Chief Engineer Middlesborough Belt Railway Middlesborough Ky., '90-'91; Division Engineer, Cauca R. R., U. S. of Colombia, 92-'93; Chief Engineer, Chicago, Indiana and Eastern Railway, Fairmount, Ind.

1886.

Jay Cullens, C. E.

Justo G. Martinez, M. E.—Assistant Chemist, Coahuila, Mexico; with Mexican International Railway; now Mine Operator at Guanacevi, Mexico.

James E. Fulcher, C. E.—Draughtsman M. P. R. R. and St. L. and S. F. R. R., '86-'87; Principal Aikinsville Institute, '88-'90; Prof. Natural Sciences and

* Dead.

Mathematics, Nacogdoches University, Texas; Prof. Natural Sciences and Mathematics, McCune College, Louisiana, Mo., Civil Engineer, St. Louis, Mo.

G. W. Cole, C. E.—U. S. Coast Survey; Engineer Mo. Pacific Ry.; now Second Lieutenant, Seventh U. S. Cavalry (by Presidential appointment), Fort Grant, Arizona.

Oscar Lachmund, M. E.—Chemist for Western Steel Co., St. Louis, Mo., 1887; Bullion Sampler for Holden Smelting Co., Denver, Colo.; with Grand View, Mining and Smelting Co., Reid, Colo.; Assayer and Chemist for Idaho Sampling Works, Idaho City, Colo.

George B. Wiles, C. E.—With St. Louis Bridge & Iron Co., St. Louis, Mo.

W. Meritt Yeater, M. E.—City Engineer, Sedalia, Mo.

1890.

George Reginald Dean, C. E.—See 1891.

1891.

George Reginald Dean, C. E., B. S.—Assistant in Mathematics and Engineering, Missouri School of Mines; Prof. of Mathematics, Maryville Seminary, Maryville, Mo.; Prof. of Mathematics and Engineering, Coe College, Iowa; Assistant in Leander McCormick Observatory, University of Virginia; Computer for J. A. F. Waddell, Bridge Engineer, Kansas City, Mo.; Instructor in Mathematics, Central High School, Kansas City, Mo.

Sallie Elizabeth Millard, B. S. (in General Science).—First Assistant Vichy Normal Institute, Vichy, Mo.; Teacher, Carthage, Mo.

Frank H. Seamon, M. E.—Chemist and Assayer, Vacas Mining and Smelting Co., Mina de Vacas, Estado de Durango, Mexico; Chemist for Guanacevi Mining Co., Guanacevi, Mexico; Ore buyer for La Gran Fundicion Nacional Mexicana, Pachuca, Mexico.

Arthur J. Stewart, B. S.—Assistant in Chemistry, Missouri School of Mines; Assistant Superintendent Notalina Mining Co., La Noria, Estado de Zacatecas, Mexico; Chemist and Assayer, Guanacevi Mining Co., Guanacevi, Mexico.

1892.

Daniel C. Jackling, B. S.—Assistant in Chemistry, Missouri School of Mines, '92-'93; Chemist for Lawrence Gold Extraction Co., Lawrence, Colo.; Metallurgist and Mill Superintendent for the De La Mar Mines, Mercur, Utah.

Edward Mackay Johnson, B. Sc.—Chief Chemist for Kansas City Smelting and Refining Co., El Paso, Texas.

Fayette A. Jones, C. E., M. E.—Engineer for Union Mining Co., Phoenix, Arizona, '92-'93; Chief Engineer, New Mexico & Western Ry.; City Engineer, Independence, Mo., '94; Engineer for Old Mexico Land and Improvement Co., and Mexican Gulf Agricultural Co., Coatzacoalcos, Mexico; Consulting Engineer for the "Elephant Gold & Copper

Co.," Office, Kansas City, Mo., and Gen. Manager and Engineer of the "Allen Gold Mining, Smelting and Refining Co.," of Phoenix, Arizona.

Frank L. Tyrrell, C. E.—See 1893.

1893.

Mary Page Buskett, B. S. (in General Science).—Teacher, Eldon, Mo.

John Calum Reid, M. E.—Draughtsman, Rolla, Mo.; Assayer for Kansas City Smelting and Refining Co., Argentine, Kansas.

Clifton Bates Spencer, C. E.—C. E. Cornell University, '94; with K. C. Pittsburg & Gulf R. R., Kansas City, Mo.

Frank L. Tyrrell, C. E., M. E.—Assayer for Kansas City Smelting and Refining Co., Argentine, Kansas.

1894.

Theodore S. DeLay, B. S.—Assistant Professor of Chemistry, New Mexico School of Mines; Assayer, Victor, Colorado; Assayer for the I. X. L. Mining and Reduction Co., Swan, Colorado.

Temple Dyer, C. E.—See 1895.

Claude D. Grove, B. S. (in C. E. and M. E.)—Assayer for Lawrence Gold Extraction Co., Lawrence, Colo.; U. S. Dep. Mineral Surveyor, with Colo.-Phila. Reduction Co., Colorado City, Colo.

George W. Herdman, C. E., Draughtsman in office of Mr. H. H. Hohenschild, Architect, Rolla, Mo. Transitman for Mr. C. W. Wells, Engineer, Victor, Colorado.

William S. Thomas, B. S.—Assistant in Chemical Laboratory, Missouri School of Mines, '95; Head Assayer, Anaconda Mining Co., Belt, Montana.

1895.

Evans Walker Buskett, B. S.—Chemist for Mound City Paint Works, St. Louis, Mo.

Herman Cyril Cowen, B. S.—Engineer (in charge of masonry construction) for the Stanwix Engineering Co., Schenectady, N. Y.

Edward P. Dwyer, B. S.—Chemist for Empire Zinc Co., Joplin, Mo.

Temple Dyer, B. S.—Lumber Merchant, Rolla, Mo.

Philip Florreich, B. S.—With U. S. River Commission, St. Louis, Mo.

Samuel James Gormly, B. S.—Professor of Mathematics and Engineering, New Mexico School of Mines, Socorro, New Mexico.

John Edward Kirkham, B. S.—Draughtsman for Mr. J. A. L. Waddell, Bridge Engineer, Kansas City, Mo.

1896.

Claude Devlin Grove (B. S. 1894), E. M.—See 1894.

Walter Guy Martin, B. S.—Mine Operator, Ohio City, Colorado.

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